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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

World Power Conference (Second Notice).

The British Empire Exhibition (Twelfth Notice).

The James Forrest Lecture.

100 Years of British Railways—No. II.

Heat Engine and Boiler Trials.

Electric Transmission and Distribution.

The "Bristol Bloodhound" Biplane.

Royal Agricultural Show—No. III.

A New Rack Locomotive.

Standard Tests for Hydraulic Power Plants.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere road, Lambeth, S.E. 1. REQUIRES :—
1. WHEELS, CHILLED CAST IRON.
2. UNIVERSAL COUPLINGS FOR VACUUM BRAKES.
Tenders due on the 22nd July, 1924. Tender forms obtainable from above. 6387

G. R.

BY DIRECTION OF THE SURPLUS STORES, ETC., LIQUIDATION DEPARTMENT, H.M. TREASURY.

The Department Invites Tenders for the PURCHASE of the COMPONENT PARTS of about 4000 FREIGHT CARS of Russian Railway Gauge, lying in Canada (approximately 43,000 tons).

The components are offered for export only in One Lot as they lie.

Sale conditions and particulars, together with form of Tender, can be obtained from the Secretary, Treasury Surplus Stores, &c., Liquidation Department, Caxton House, Tothill-street, Westminster, London, S.W. 1, or from Mr. J. H. Francis, 65, Broadway, 10th Floor, New York City. Mr. Francis will furnish the necessary permits to inspect the material.

Sealed Tenders, in the envelopes supplied, should be sent direct to

THE SECRETARY,
TREASURY SURPLUS STORES, &c.,
LIQUIDATION DEPARTMENT,

so as to be received not later than 20th August, 1924. 6354

Temporary Engineering ASSISTANTS REQUIRED for Government Department.

Candidates must have served in H.M. Forces during war, have had good training and experience in Municipal, County or Civil Engineers' Offices, and be fully capable of Preparing Designs, Working Drawings and Specifications for Drainage and Sewage Disposal Works, Water Supply Schemes and General Civil Engineering Work, or, alternatively, for the Design of Heavy Steel and Ferro-concrete Structures.

The normal maximum salary attached to these posts is £275 p.a., inclusive of Civil Service bonus, but salaries will be assessed according to the qualifications and experience of the candidates selected.

Written applications, with full details of experience, qualifications, age and salary required, should be addressed to the JOINT SUBSTITUTION BOARD (Treasury and Ministry of Labour), Montagu House, Whitehall, S.W. 1. Replies will be sent only to such candidates as appear suitable for interview. 6374

University of Liverpool,

FACULTY OF ENGINEERING.

DEAN: Professor T. B. ABELL, O.B.E., M.Eng., F.C.N.C. Inst., M. Inst. N.A.

The University awards the Degrees of B.Eng., M.Eng., D.Eng., Ph.D., and a Certificate and Diploma in Engineering.

Degree Candidates must pass an approved Matriculation Examination. Candidates for a Certificate (which leads to a Diploma) must have (i) been engaged in Practical Engineering, (ii) followed approved courses in a Technical School.

The Courses are designed for students desiring to qualify as MECHANICAL, ELECTRICAL, CIVIL or MARINE ENGINEERS, as NAVAL ARCHITECTS and METALLURGISTS or METALLURGICAL ENGINEERS. The Courses cover the subjects of examination for Associate Membership of the Institutions of Civil, Mechanical and Electrical Engineers. The Institutions named, subject to certain conditions, accept the Degree of B.Eng. in lieu of part, and in some cases the whole, of the examinations for Associate Membership. The various Departments are housed in commodious and well-equipped buildings, and provide ample facilities for research.

A prospectus of the Faculty, giving particulars of Courses and a large number of Entrance and Post-graduate Scholarships, may be had on application to the undersigned.

EDWARD CAREY, Registrar.
6206

University College of Swansea.

AN EXAMINATION for the SOUTH WALES INSTITUTE of ENGINEERS' SCHOLARSHIP in ENGINEERING, of the value of £70 per annum, tenable for three years, will be held at the College on SEPTEMBER 8th, 1924, and following days.

Further information and prospectuses may be obtained from the undersigned.

EDWIN DREW, Registrar.
Singleton Park, Swansea. 6340

Great Northern Railway (Ireland).

TO BRIDGE CONTRACTORS.

The Directors are prepared to receive TENDERS for the RECONSTRUCTION of a STEEL UNDERLINE BRIDGE between Knocknore Junction and Hillsborough.

The drawings and specification may be inspected at the Engineer's Offices, Dublin and Belfast, and copies of same, together with bills of quantities and forms of Tender, may be obtained from the undersigned, on payment of Two Guineas, which will be refunded on receipt of a bona fide Tender, and on return of the drawings.

Tenders, made out on the forms supplied by the Company, should be delivered, under sealed cover, endorsed "Tender for Bridgework," not later than 10 a.m. on Monday, 21st July.

The Directors do not bind themselves to accept the lowest or any Tender.

J. B. STEPHENS, Secretary.
Amiens-street Station, Dublin, 8th July, 1924. 6379

PUBLIC NOTICES

Bengal-Nagpur Railway Company Limited.

The Directors are prepared to receive TENDERS for OPEN and COVERED GOODS WAGONS and BRAKE VAN UNDERFRAMES.

Specifications and forms of Tender can be obtained at the Company's Offices, 122, Gresham House, Old Broad-street, E.C. 2, on or after 9th July, 1924.

A fee of 20s. will be charged for the specification, which is NOT returnable.

Tenders must be submitted not later than Noon on Tuesday, 22nd July, 1924.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board, R. C. VOLKERS, Secretary.
6346

London and North-Eastern Railway.

TO BUILDERS AND IRONFOUNDERS.

The Directors are prepared to receive TENDERS for NEW ROOFING over PLATFORMS and ALTERATIONS to STATION BUILDINGS at Ashington.

Plans and specification may be seen, and quantities and further information obtained, upon application to Mr. Stephen Wilkinson, Architect, N.E. Area, L. & N.E. Rly., at Irving House, Westgate-road, Newcastle-on-Tyne, on and after 7th July.

Quantities supplied to parties tendering for the whole of the works.

Sealed Tenders, marked "Ashington Station Roofing, &c.," to be sent to the Joint Secretaries at Marylebone Station, London, N.W. 1, by not later than 9 a.m. on 21st July.

The Directors do not bind themselves to accept the lowest or any Tender.

JAMES McLAREN, G. F. THURSTON, Joint Secretaries.

Secretary's Office, L.N.E. Railway, Marylebone Station, 2nd July, 1924. 6324

Public Tenders.—Corporations and other PUBLIC BODIES are INVITED, before issuing final invitations for Tenders, to COMMUNICATE with GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION. The Corporation has available for Disposal large quantities of Plant, Machinery and Materials in good condition lying at and arising from Government Factories and Works, the employment of which may, if their lists are consulted in the first place, effect great economies.—GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION, Abbey House, 2, Victoria-street, S.W. 1. 6339

Siam State Railways.

NOTICE.

TENDERS are INVITED for the SUPPLY of ALL-STEEL GOODS WAGONS.

Specifications and drawings may be obtained against payment of £1 10s. (not returnable) from Messrs. G. P. Bandberg, 40, Grosvenor-gardens, London, S.W. 1.

Sealed Tenders, with the inscription "Tender for the Supply of All-steel Goods Wagons, B.E. 2467," must be forwarded to the undersigned, at whose office in Bangkok, Siam, they will be received up to Fourteen o'clock on the 31st October, 1924, at which place and hour the Tenders will be publicly opened and read.

Right is reserved to reject any or all Tenders, and to accept any Tender which, in the opinion of the undersigned, is to the best interests of the Siam State Railways.

Department of State Railways, Bangkok.
(Sgd.) ACTING COMMISSIONER-GENERAL.
6343

PUBLIC NOTICES

Urban District Council of Teddington.

AIR COMPRESSING PLANT.

The Council invite TENDERS for the SUPPLY, ERECTION and SETTING TO WORK of TWO SETS of HORIZONTAL COMPOUND, STEAM-DRIVEN AIR COMPRESSORS, at their Sewage Disposal Works in Broom-road, Teddington.

Each set of compressors to be capable of compressing 300 cubic feet of free air per minute to a pressure of 14 lb. per square inch above atmosphere.

Copies of the drawings and specification may be obtained on application to Mr. Marshall Hainsworth, Surveyor, Public Offices, Teddington, accompanied by a crossed cheque for £5, payable to the Council, which deposit will be returned upon the receipt of a bona fide Tender.

Sealed Tenders and other details described in the specification to be delivered to the undersigned on or before Thursday, the 31st instant.

The Council do not bind themselves to accept the lowest or any Tender.

By Order, G. H. SALMONS, Clerk to the Council.
Council Offices, Teddington, 2nd July, 1924. 6336

Worthing Corporation Waterworks.

LONGFURLONG SUPPLY.
CONTRACTS Nos. 1 AND 2.

The Corporation of Worthing invite TENDERS for the CONSTRUCTION of TWO BORE-HOLES (Contract No. 1) and for the SUPPLY of about 240 Tons of CAST IRON SOCKET PIPES, 14in. dia. (Contract No. 2).

Specifications, with form of Tender, general conditions and drawings, in respect of each contract may be inspected and obtained (on payment of Three Guineas, returnable if a bona fide Tender be made) on application at the Water Engineer's Office, Municipal Offices, Tudor Lodge, Chapel-road, Worthing, or at the office of T. and C. Hawksley, Civil Engineers, 24, Old Queen-street, Westminster, S.W. 1, on and after the 11th inst.

Tenders, endorsed "Waterworks," must be delivered at the Municipal Offices at or before Twelve o'clock Noon on Thursday, the 24th instant.

The Corporation do not pledge themselves to accept the lowest or other Tender.

J. KENNEDY ALLERTON, Town Clerk.
Worthing, July, 1924. 6356

County Borough of Wolverhampton.

DEPUTY WATER ENGINEER.

The Council are prepared to receive APPLICATIONS from qualified Engineers for the above POSITION, for which a salary and bonus of £400 per annum will be paid, advancing by two annual increments of £25, subject to satisfactory service.

The Council having adopted the Local Government and other Officers' Superannuation Act, 1925, the appointment will be subject to percentage deductions in accordance with the provisions of the Act.

Applications, stating age, experience, qualifications and present salary, together with copies of three recent testimonials, must be delivered to my office before Noon on Friday, the 18th inst.

Canvassing members of the Council personally or otherwise will disqualify applicants.

(Sgd.) E. A. B. WOODWARD, Water Engineer and Manager.
Town Hall, Wolverhampton, 2nd July, 1924. 6310

PUBLIC NOTICES

In the High Court of Justice (Companies Winding Up).

To be Offered for Sale by TENDER, pursuant to an Order of the Registrar Companies (Winding Up), made in the matter of ALLEN and SIMMONDS (READING), Ltd., Branch Nominees, Ltd., v. Allen and Simmonds (Reading), Ltd., 1923 A., No. 2532, either in ONE LOT as a GOING CONCERN or in the following LOTS :—

LOT 1.

(a) A FREEHOLD GARAGE, SHOWROOMS and OFFICES, situate in the centre of READING, with frontages to Friar-street and Station-road, and containing an area of about 23,000 square feet, together with the ASSETS and the BUSINESS carried on on such premises, and the whole of the SHARE CAPITAL and DEBENTURES in GREAT WESTERN MOTORS, Ltd.

(b) A BLOCK of TEN FREEHOLD COTTAGES adjoining the above.

(c) A FREEHOLD FACTORY at Western-road, READING, with Modern Buildings thereon, covering an area of about 14,500 square feet, at present let as a Motor Body Building Works, in connection with the aforesaid business.

LOT 2.

(a) A LEASEHOLD ENGINEERING WORKS at READING, containing a total floor space of about 27,000 square feet, held for an unexpired term of 67 years at ground rents amounting to £77 6s. per annum. These Works are equipped with high-class ENGINEERS' MACHINE TOOLS for the manufacture of Piston Rings and other Specialities of the Company.

(b) THIRTY LEASEHOLD COTTAGES and a RESIDENCE adjoining, held for a similar period at nominal ground rents.

(c) LEASEHOLD PREMISES, suitable for Garages, situate No. 107, Caversham-road, READING, held for an unexpired term of 61 years.

(d) A FREEHOLD PROPERTY on the THAMES at CAVERSHAM, adjoining the Bridge, formerly a Club, but now let off in self-contained Flats.

(e) A FREEHOLD HOUSE, No. 18, King's Meadow-road, READING.

(f) The GOODWILL of the BUSINESS of ALLEN and SIMMONDS (READING), Ltd., as a GOING CONCERN and LETTERS PATENT for "Improvements in the Manufacture of Piston Rings, &c."

LOT 3.

3000 £1 FULLY PAID SHARES, GREAT WESTERN HOTEL (READING), Ltd.
25 £1 FULLY PAID DEFERRED ORDINARY SHARES, and
5500 £1 FULLY PAID PARTICIPATING PREFERRED ORDINARY SHARES in the READING FOUNDRY CO., Ltd.

Tenders, which must be on the form contained in the particulars, are to be sent to the Registrar, Companies (Winding Up), Room 48, Bankruptcy-buildings, Carey-street, W.C. 1, and marked "Tender re Allen and Simmonds (Reading), Ltd.," and delivered under seal by Twelve Noon on or before Saturday, 19th July, 1924.

Particulars, with plan, form of Tender, and conditions of sale, may be had of Messrs. W. B. PEAT and CO., Chartered Accountants, 11, Ironmonger-lane, London, E.C. 2; Messrs. WILDE, WIGSTON and SAPTE, Solicitors, 21, College-hill, London, E.C. 4; and of Messrs. PEACOCK and GODDARD, of 3, South-square, Gray's Inn, London, W.C. 1. 6046

Burgh of Girvan.

RESIDENT ENGINEER FOR HARBOUR WORKS.

The Girvan Town Council invite APPLICATIONS for the POST of RESIDENT ENGINEER in connection with proposed Harbour Improvements. Applicants must have experience of Harbour Works, and be accustomed to Diving and capable of keeping careful Cost Records and Accounts.

Applications, which should be accompanied by copies of testimonials, stating salary required, should be submitted to JAMES SMITH, Town Clerk, Girvan, not later than 18th July. 6342

City of Wakefield Waterworks.

APPLICATIONS are INVITED for the APPOINTMENT of TEMPORARY ENGINEERING ASSISTANT.

Candidates must have passed the Associate Membership Examination of the Institution of Civil Engineers and have had experience in surveys for and working drawings of Trunk Mains, River and other Crossings, and Mechanical Filtration Plant.

Salary at the rate of £270 per annum.

Applications, stating age, nationality, qualifications and experience, with copies of three recent testimonials, to be forwarded to C. CLEMESHA SMITH, Waterworks Engineer, Town Hall, Wakefield, not later than Monday, 28th July. 6336

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 4.
PARTNERSHIPS, Page 2.
MACHINERY, &c., WANTED, Page 4.
FOR SALE, Page 4.
AUCTIONS, Pages 3 and 100.
PREMISES TO LET OR WANTED Page 4.
WORK WANTED, Page 4.
AGENCIES, Page 2.
MISCELLANEOUS, Page 2.

For Advertisement Rates see Page 47, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS, Page 99.

PUBLIC NOTICES

County of Surrey.
HIGHWAYS AND BRIDGES DEPARTMENT.
RUINS BRIDGE RECONSTRUCTION.

APPLICATIONS are INVITED for the APPOINTMENT of CLERK OF WORKS to act under the directions of the County Surveyor, to Take Charge of the Works comprised in the Reconstruction of Ruins Bridge, Virginia Water, which is being done under contract. Salary at the rate of £6 per week.

Applications, in writing, stating full particulars of appointments held and experience on Bridge and Reinforced Concrete Works, accompanied by references, should reach the undersigned not later than Friday, the 18th of July, 1924.

Forms of application and further particulars may be obtained from the undersigned. Stamped addressed envelope should be forwarded.

W. F. ROBINSON, A.M. Inst. C.E.,
County Surveyor.

County Hall,
Kingston-on-Thames,
7th July, 1924. 6351

County of Surrey.
HIGHWAYS AND BRIDGES DEPARTMENT.
ARTERIAL ROADS.

APPLICATIONS are INVITED for the APPOINTMENT of an ASSISTANT RESIDENT ENGINEER, to act under the directions of and to assist the Resident Engineer in the Supervision and Construction of the Kingston By-pass Road. Salary at the rate of £6 per week.

Applications, in writing, stating full particulars of appointments held and experience on similar works, accompanied by references, should reach the undersigned not later than Friday, the 18th of July, 1924.

Forms of application and further particulars may be obtained from the undersigned. Stamped addressed envelope should be forwarded.

W. F. ROBINSON, A.M. Inst. C.E.,
County Surveyor.

County Hall,
Kingston-on-Thames,
7th July, 1924. 6352

SITUATIONS OPEN

WANTED, as ASSISTANT to WORKS MANAGER in large General Piercing and Stamping Works in Midlands, an ENGINEERS' DRAUGHTSMAN, with experience in Planning and General Reconstruction, including buildings. Knowledge of jig and tool design and special machine construction an advantage. State age and salary required, giving full details of previous occupation.—Address, 6353, The Engineer Office. 6353 A

WANTED, CHIEF ENGINEER and DRAUGHTSMAN for old-established Gas and Chemical Engineers in North of England. Must be good practical as well as theoretical engineer. Permanent position for good man. State age, salary, and full particulars.—Address, 6360, The Engineer Office. 6360 A

WANTED for a Leading Structural Engineering concern in India, a First-class STRUCTURAL DESIGNER. Ordinary draughtsman is not required. Age not to exceed 35 years; must be thoroughly competent. Really good prospects.—Write, stating full particulars and salary required, to Z.C. 957, c.o. Deacon's Advertisement Agency, Leadenhall-street, London, E.C. 3. 6375 A

WANTED for a Proposed Fuel Economy Bureau, a GENTLEMAN with an intimate theoretical and practical knowledge in the use of instruments for the boiler plant. Must have tact, energy and a public school education (not necessarily university). State full particulars.—Address, P9317, The Engineer Office. P9317 A

WANTED, MANAGER by Old-established Marine Engineering and Ship Repairing Firm: must have draughts-office experience and a good knowledge of workshop practice and ship and machinery repairs. A good opening for a first-class man.—Address, stating age, experience, and salary required, AMOS and SMITH, Ltd., Hull. 6354 A

WANTED by Well-known Engineers in the North, WORKS MANAGER; knowledge of Gearing essential. State qualifications and salary required.—Address, 6370, The Engineer Office. 6370 A

A FIRM of Structural Engineers in India REQUIRE an ASSISTANT to a WORKS MANAGER; must be unmarried, trained engineer and have served apprenticeship with a reputable firm; knowledge of Construction of Light Bridge Work and General Structural Work essential from receipt of drawings to inspection, including Supervision and Checking, and setting out and templating. Will be required to sign a 3 years' agreement. Age not to exceed 30. Salary to commence at Rs. 400 per month.—Apply, in writing, with copies of testimonials and photograph, if possible, to ALEX. LAWRIE and CO., 17, St. Mary-axe, London, E.C. 3. 6376 A

BROWN, BOVERI and CO., Limited, REQUIRE for their Refrigerating Machine Department (which deals with a small refrigerating machine of special construction, made in four standard sizes) an ESTIMATING ENGINEER, with knowledge of this class of work. A young man is required, about 28 to 30, preferably unmarried, with college education, Drawing-office experience, and not less than five years' General Engineering Experience, some of which must have been in connection with Refrigerating Machinery.—Apply in writing, giving full particulars, to Trafalgar House, Waterloo-place, London, S.W. 1. P9326 A

CONTINENTAL ENGINEERS REQUIRE JUNIOR ASSISTANT; fully qualified to Inspect and Test Castings and various classes of Materials at Rolling Mills, also Finished Engineering Work, &c. State salary required and previous experience.—Address, 6382, The Engineer Office. 6382 A

CONTRACTORS' AGENT and ENGINEER WANTED, to Take Charge of Contract near London. Must be thoroughly experienced in modern methods of Reinforced Concrete Bridge Work, including copper dams, piling, temporary work, &c.—Write, Box 1546, Sells Advertising Offices, Fleet street, E.C. 4. 6357 A

FOUNDRY METALLURGIST REQUIRED, with sufficient experience to take charge of the management of a foundry dealing with cast iron, semi-steel, steel, and non-ferrous metals. Only scientists with practical experience and sips judgment need apply.—Write, giving full particulars of experience, age, and salary required, BAKER PERKINS, Limited, Westwood Works, Peterborough. 6325 A

FOUNDRY SUPERINTENDENT REQUIRED, with knowledge of Metallurgy and up-to-date experience in Cast Iron, Semi-steel, Steel, and Non-ferrous Alloys. Only practical men with sound judgment need apply.—Address, stating age, salary required, and particulars of experience, 6326, The Engineer Office. 6326 A

INDIA.—WANTED, First-class MAN as MANAGER of Railway Wagon Department of important Engineering Firm. Excellent opportunity for thoroughly capable man.—Write, stating age, with full particulars of training and experience and copies of testimonials, to Z. H. 940, c/o Deacon's, Leadenhall-street, London, E.C. 3. 6361 A

MACHINE TOOL REPRESENTATIVE WANTED for large firm; well educated, competent and experienced, of good address. Also JUNIOR REPRESENTATIVE. Fullest information as to training, experience, education, salary required, &c., in strict confidence.—Address, 6381, The Engineer Office. 6381 A

MACHINE TOOL SALESMAN as ASSISTANT. Experience in other mechanical engineering lines an advantage, but a sound machine tool experience is essential. Salary £300/£400.—Write, Box 562, Dorland Agency, 14, Regent-street, S.W. 1. P9314 A

REDUCTION WORKS ASSISTANT, with Mechanical experience, REQUIRED for Gold Mine, West Africa.—Address, stating age and experience, with copies of testimonials, 6390, The Engineer Office. 6390 A

Messrs. SCHWEGLER BROS., WATTWIL (Switzerland),
Manufacturers of the
"HELVETICA" BALL BEARINGS,
are open to engage firm of good standing, and with good trade connection, for the sale of their speciality in Great Britain.

SITUATIONS OPEN (continued)

THE BRITISH REINFORCED CONCRETE ENGINEERING CO., Ltd., REQUIRE the SERVICES of TWO JUNIOR TRAVELLERS with a knowledge of Reinforced Concrete Construction. Previous travelling experience not essential, but applicants must be of good appearance and address.—Replies, stating age, qualification, and salary required, should be marked "Junior Travellers" and addressed to 1, Dickinson-street, Manchester. 6369 A

TWO First-class STEEL WORK DESIGNERS REQUIRED, with good theoretical and practical training in the calculations, details and drawings for Steel-framed Buildings and other Structural Steel Work.

Only competent designers with experience in contractors' works will be considered, and preference will be given to those having also designing experience in timber structures, foundations, and retaining walls.

Reply by letter, stating age, qualifications, experience, and salary required, to Box N. P., Charles Barker and Sons, 31, Budge-row, E.C. 4. 6355 A

YOUNG MAN WANTED, Capable of Being Trained as Buyer for a Machinery Dealing Firm. Some knowledge of machinery, honesty, common sense, confidence, responsibility, and "savvy" essential. Send full particulars.—Address, 6371, The Engineer Office. 6371 A

WANTED, DRAUGHTSMAN, Used to Hydraulic Work.—Apply by letter, stating age, experience, and salary required, to THE HYDRAULIC ENGINEERING CO., Ltd., Chester. 6389 A

WANTED, Experienced DRAUGHTSMAN, Modern Steam Engine Practice and General Work. State age, experience, salary required.—Address, 6251, The Engineer Office. 6251 A

WANTED, Neat DRAUGHTSMAN, Experienced in Building Work and Steel Construction Details.—Address, 6364, The Engineer Office. 6364 A

DRAUGHTSMAN REQUIRED, First-class, for general engineering; one with knowledge of Sugar Machinery preferred.—Address, 6372, The Engineer Office. 6372 A

DRAUGHTSMAN, SENIOR, Mechanical-Electrical, WANTED, with first-class experience of Large A.C. and D.C. Machines, Midlands Works.—Address stating age, qualifications, experience, and salary, 6141, The Engineer Office. 6141 A

DRAUGHTSMAN WANTED by Firm in the Midlands manufacturing Municipal Vehicles. Applicants should state age, experience, and salary required and enclose copies of references.—Address, P9293, The Engineer Office. P9293 A

DRAUGHTSMAN WANTED for Liverpool; Knowledge of Compressor Design essential.—Address, 6349, The Engineer Office. 6349 A

EXPERIENCED DRAUGHTSMAN, with Knowledge of Pumping Plant, Buildings, Pipe Lines, &c., REQUIRED in Water Engineer's Office. A salary of four guineas per week will be paid.—Applications, stating age, training, qualifications, and experience, must be received by me not later than Friday, the 18th inst.—E. A. B. WOODWARD, Water Engineer and Manager, Wolverhampton. 6309 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED, for North-East Coast. Must have had experience on Heavy Bridge Work, Foundations, Buildings, &c.; designing, preparing drawings for shops and estimating. State salary required. Others need not apply.—Address, 6305, The Engineer Office. 6305 A

GOOD DRAUGHTSMAN for Constructional Steel Work REQUIRED AT ONCE in North London office. Must be familiar with requirements of Steel-framed Building Act and thoroughly conversant with this type of work for preparation of shop drawings. Some knowledge of design also is essential.—Address, P9321, The Engineer Office, stating age, experience, salary required, and when free for engagement. P9321 A

INDIA.—STRUCTURAL DRAUGHTSMAN, Young unmarried man, REQUIRED, with good practical experience of Bridge and Light Structural Work and sound knowledge of the theoretical side. Good opening for capable man with initiative.—Write with full details of training and experience and copies of testimonials, and stating salary required, to Z. J. 898, c/o Deacon's, Leadenhall-street, London, E.C. 3. 6332 A

LEADING DRAUGHTSMAN REQUIRED for Design of Paraffin and Semi-Diesel Marine Motors; must have had thorough training and experience.—Address, stating age, details of experience and salary required, &c., H. W. BAMBER, 166, Piccadilly, London, W. 1. 6378 A

PUMPING MACHINERY. — DRAUGHTSMAN WANTED, capable of designing and calculating. State experience, age, and salary required.—Address 6022, The Engineer Office. 6022 A

TWO LEADING DRAUGHTSMEN REQUIRED, with experience in Admiralty Destroyers, one for arrangements and one for turbines. Only those having held similar positions and who are thoroughly experienced need apply.—Reply by letter only, stating age, experience, and salary required, to R. D. YARROW and CO., Scotstoun, Glasgow. 6322 A

FOREMAN REQD. for Assembly Dept. Large works, London, producing Motor Car Clocks. Must be technically efficient on instrument making generally, first-class organiser, and capable controlling large staff female operators.—Address, P9269, The Engineer Office. P9269 A

FOREMAN REQUIRED for Steam and Electric Crane Works in Midlands employing 60 men, machine, fitting and structural shops. Must be capable of producing first-class work on piecework at competitive prices and be good organiser and disciplinarian. State experience, salary, and when free.—Address, 6370, The Engineer Office. 6313 A

SITUATIONS WANTED

ADVERTISER DESIRES Responsible POSITION, Purchasing and sales, engineers' tools and stores, castings, constructional steel work. Good technical knowledge.—Address, P9340, The Engineer Office. P9340 B

AMBITIOUS YOUNG MAN, Unlimited Abilities, excellent technical education, over 6 years' experience, building work, including design structural steel and reinforced concrete, REQUIRES POST in London, preferably consulting engineers; moderate salary to commence.—Address, P9327, The Engineer Office. P9327 B

SITUATIONS WANTED (continued)

A YOUNG MECHANICAL ENGINEER, Aged 22 years, SEEKS SITUATION in Drawing-office; 5½ years' good all-round experience in locomotive works and drawing-office; reliable, quick and accurate; low wage for good prospects.—Address, P9307, The Engineer Office. P9307 B

B.Sc. ENG. (London), Age 27, 11 Years Shops, including 5 years Apps., SEEKS RESPONSIBLE POSITION.—Address, P9323, The Engineer Office. P9323 B

CIVIL ENGINEER and ESTIMATOR for Buildings and alterations, public works and London experience; good draughtsman; will recommended; age 33.—Address, P9325, The Engineer Office. P9325 B

CIVIL ENGINEER, University-trained, 14 Years' technical and commercial experience, SEEKS RESPONSIBLE APPOINTMENT; thoroughly experienced in carrying out all classes of building construction, surveying, D.O., &c.; experienced in modern factory management, control of staff and labour, &c.; thoroughly competent to represent firm of good standing.—Address, P9281, The Engineer Office. P9281 B

ENGINEER (27), Fitter, Turner and Millwright, SEEKS good permanent SITUATION, works or maintenance; 11½ years shops, 2½ years marine; good refs.—A. D., 44, Cranfield road, London, S.E. 4. P9329 B

ENGINEER (31), Experienced in Marine and Locomotive work, able to speak French, Italian and Arabic fluently, at present in the East, SEEKS POSITION.—Write, Box 1548, Sells, 167, Fleet-street, E.C. 4. 6360 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Destroyer Flotilla in the Thames.

THE Fifth Destroyer Flotilla arrived in the Thames on Tuesday for a visit of seven days. The ships have anchored off Gravesend and Greenhithe, as in view of their size and draught it has not been possible to provide berthing accommodation higher up the river. The force, which consists of the flotilla leader Malcolm and eight destroyers, is under the command of Captain E. O. B. S. Osborne, D.S.O. The Malcolm was laid down in March, 1918, under the emergency war programme, but was not completed until the end of the following year. She displaces 1800 tons at normal draught and about 2050 tons at full load. She is equipped with Parsons geared turbines of 40,000 shaft horse-power and Yarrow boilers, designed for a speed of 36.5 knots. Five 4.7in. guns are mounted on the centre line, two of these being superposed to fire over the guns below. There are also three A.A. guns and six 21in. torpedo tubes. The complement numbers 181 officers and men. The eight destroyers are Vimiera, Vivacious, Vendetta, Vampire, Voyager, Walrus, Waterhen, and Wryneck. All except the last named were completed in time to take an active part in the war. The class to which they belong has the following characteristics:—Displacement, 1300 tons; geared turbine machinery of 27,000 shaft horse-power for a speed of 34 knots; armament, four 4in. guns, one 3in. A.A. gun, six 21in. torpedo tubes; complement, 120. Although not of the very latest construction, these eight boats are fairly typical of the modern British destroyer, while the Malcolm belongs to the newest class of flotilla leaders.

Tidal Power.

THE proposal to construct an experimental tidal power generating station at Aber Wrac'h, which will supply electrical energy to Brest, appears to be passing out of the preliminary stage. The State Council is now considering to what extent the French Government will participate financially in the enterprise. It is believed that this participation will amount to 10 million francs. The remainder of the sum required will be supplied by a company to be formed for the purpose. The plans have long been completed, and provide for the laying down of two plants, one with a special type of reversible turbine for utilising the tides and the other for employing the power provided by a barrage across the mouth of the neighbouring river Diouris, this latter plant being intended to regulate the supply. The intention is to make the station self-supporting by distributing current to Brest, and at the same time to carry out experimental work with a view to the construction of other tidal power stations along the coast, if it be found at all practicable.

A High Pressure Cable.

A REPORT issued by the American General Electric Company states that a 66,000-volt cable has recently been put into operation in Cleveland, Ohio. This cable works at a 50 per cent. higher pressure than any other cable in the United States, and it also carries twice as much power as any other American underground cable. The cable has been laid in a thickly populated district, where overhead lines were out of the question. The total length of the cable is about 200,000ft. and manholes are placed at intervals of about 400ft. When the work had been completed, the cable was tested at a pressure of 152,000 volts by means of one of the General Electric Company's Kenetron cable-testing equipments, which are designed to give very high direct-current pressures. Considerable attention is being paid at the present time to the design of super-pressure cables, for it is well known that the use of transmission lines is not always permissible. In Italy, for instance, experiments are being carried out with a view to transmitting three-phase current at 130,000 volts over three single conductor cables.

The Oldest Ship in Service.

YESTERDAY (Thursday) there took place at Barcelona and adjacent Spanish ports an interesting ceremony in commemoration of the centenary of the sailing ship Nuestra Señor del Mar, which it is believed is the oldest ship in the world which is still in service. This ship was completed on July 10th, 1824, and has been in service ever since, and still puts out to sea. During the commemoration festival she is being escorted by a number of sailing ships and aeroplanes, and is visiting various ports. During the war this veteran ship made several voyages to America.

The Exhibition Buildings.

MANY people on visiting the Empire Exhibition have expressed surprise at the fact that the majority of the buildings have been constructed in concrete instead of the stucco and similar materials rendered familiar by other Exhibitions. The fact is, of course, that the use of concrete not only gave the structures a permanent character but formed the cheapest method of building them. Speaking a few days ago on the subject before a meeting of the Institution of Municipal and County Engineers, Sir E. O. Williams, the consulting engineer to the Exhibition, said that the use of concrete for the principal buildings secured economy, trustworthiness, speedy construction and the fulfilment of architectural requirements. Comparing the cost of the Palaces of Engineering and Industry, he stated that per square foot of floor area the cost was only 25 per cent. more than that of the White City Exhibition buildings, although those buildings were erected when materials were but half as expensive as they were to-day. Altogether two hundred thousand tons of concrete had been placed at Wembley without a single failure.

The Underground Railways Extension to Kennington.

THE Hampstead and Highgate section of the London Electric Railways, except for the recently opened connection with the City and South London, ends at Charing Cross. Trains reverse there by means of a loop which has only a single platform, and the unloading and loading do not proceed quickly enough. Exchange with the Metropolitan District and the Baker-street and Waterloo lines is also made at Charing Cross. It is a very busy station and the remedy sought for the congestion at it is an extension of the Hampstead and Highgate line under the river to Waterloo, where it would have its own station, and on to Kennington. The extension would provide relief in many directions. Passengers, for instance, to and from Waterloo would not need to change nor would they need to use the Baker-street and Waterloo trains, nor, further, swell the crowds at Charing Cross. The time now spent at Charing Cross in unloading one train before intending passengers can entrain would, moreover, be saved. Reversing would still be done by a loop, but it would be at Kennington, a much less busy station than Charing Cross. A yet further advantage would be that as the City and South London is already at Kennington there could be interchange with that line, thus giving access to and from Clapham Common and the stations on the Morden extension. It is proposed to provide a physical junction between the two lines at Kennington so that through trains may run from Euston, Charing Cross and Waterloo to the Morden line and *vice versâ*. The Kennington extension would provide the fourth tunnel under the Thames.

The Scapa Flow Salvage Operations.

AFTER some months of careful preparation on the part of Cox and Danks, Limited, the first attempt to lift one of the units of the scuttled German fleet at Scapa Flow was made on Sunday morning last. The vessel chosen was the destroyer V 70, which was to be lifted bodily by means of hawsers passed under the ship and attached to winches on floating docks stationed at either side of the submerged vessel. During the previous two weeks preliminary operations were completed and the funnels and masts of the destroyer were removed. Ideal sea conditions obtained on Saturday evening, and at the close of the day all the hawsers were hauled tight so that the bow of the vessel was above water. On Sunday morning the final lifting operations were begun, but when the ship had been raised about 7ft. clear of the bottom one of the chains snapped and others quickly followed until only two wire straps held. It was not considered safe to tow the dock and destroyer to shallow water in this condition, so the winches were run back and the ship was again allowed to sink. Mr. Cox, who is in charge of the work, expressed himself as not unduly depressed by the results of the first effort. It is expected that the next attempt will be made in about two weeks' time, when wire straps only will be used for lifting the ship.

A New Industrial District for London.

IN a Journal note last week we placed on record the decision of the Committee of the House of Lords to refuse to sanction a Bill for the construction of the West Thurrock Wharf and railway connections, on the ground that it was within the power of the Port of London Authority to grant a licence for the construction of the works outlined in the Bill. It is now understood that the Thames Land Company, Limited, will make application to the Port of London Authority for a general licence to construct a deep-water wharf on the north side of the Thames at West Thurrock in connection with the proposed development there of a new industrial district.

Airship Production Appointments.

IN connection with the Government's programme for the production of two 5,000,000 cubic feet airships, one of which is to be built at the Cardington Airship Works, near Bedford, the Air Ministry has made several appointments. Group Captain P. E. M. Fellowes has been made Director of Airship Development, Squadron Leader R. B. B. Colmore has been appointed Deputy in Charge of Planning, Major G. H. Scott has been given the post of Officer in Charge of Flying, and Mr. H. B. Wyn-Evans that of Officer in Charge of Design and Construction. Lieut.-Colonel V. C. Richmond has been appointed Head of the Design and Research Section, and Mr. R. F. Hubbard has received the post of Works Manager. The second airship, it is intended, is to be built by private enterprise. The Airship Guarantee Company, the organisation with which Commander Burney, Vickers, and the Shell-Mex Company are connected, is to be invited to tender for its construction.

America and Motor Ships.

SOME time ago it was announced that the United States Congress had voted the sum of 25,000,000 dollars for the purpose of rehabilitating the commercial ships of the United States Shipping Board by converting the best of them into motor ships. A statement recently made by the Chairman of the Board, Mr. T. V. O'Connor, shows that 375 ships of the present idle fleet are considered suitable for this purpose. These ships, we learn, are well preserved and are on the average about five years old. They include hulls of varying types and sizes. It is expected that if the sum voted is judiciously spent over a period of years it will suffice to convert about sixty large ships aggregating approximately 600,000 tons deadweight. As a preliminary step in the extensive reconditioning programme—as yet only outlined—the Board has tentatively selected twelve vessels of 8800 to 9400 tons deadweight capacity for conversion. Single-screw Diesel oil engine machinery of about 2600 shaft horse-power, designed to give a service speed of 11 knots when fully loaded, is to be fitted. As far as possible standard types of machinery will be employed with electrically operated auxiliaries. The effect of the policy of the Board in selling its hulls at nominal prices should enable reconditioned ships to be placed in service at keenly competitive prices compared with new tonnage built in British and continental yards. The working of the scheme will be closely watched by British shipowning interests.

The Channel Tunnel.

IT would appear that once again the Channel Tunnel scheme must be written down as definitely abandoned. It is true that a Select Committee of the two Houses of Parliament may be appointed to hold a public inquiry into the scheme, but it is all but certain that, even though such a Committee pronounced a favourable opinion, its judgment would not be allowed to override the adverse decision given with great unanimity by the Committee of Imperial Defence. The salient point in that Committee's decision as expounded by Mr. MacDonald in the House of Commons on Monday appears to be the view that all the naval, military and air developments of the last five years have without exception tended to make the Channel Tunnel not a less, but a more, dangerous experiment. The scheme, it was further stated by the Prime Minister, was held by the Committee to offer very slight attractions and considerable disadvantages from the military point of view. On the commercial side it was held that the tunnel would have but little effect on the foreign trade of this country and that it would stand or fall by the passenger traffic which it succeeded in attracting.

A Cunard Line Anniversary.

FRIDAY last, July 4th, marked the eightieth anniversary of the first crossing of the Atlantic by a Cunard mail steamer. The ship which sailed from Liverpool on Independence Day—Friday, July 4th—1844, was the Britannia, one of four paddle steamers built on the Clyde. The Britannia was built by Robert Duncan, and was fitted with side-lever engines by Robert Napier. She was 207ft. long by 34ft. 4in. broad, with a moulded depth of 24ft. 4in., and her gross tonnage was about 1154 tons. A cargo capacity of 225 tons, with accommodation for 115 cabin passengers, was provided. Her engines were designed to develop 740 indicated horse-power, giving an average speed of 8½ knots on a coal consumption of 38 tons per day, and the voyage to Boston lasted 14 days and 8 hours. It is interesting to compare the 1154 gross tons of the Britannia with the 52,117 gross tons of the modern Berengaria, and her speed of 8½ knots with the record 27-knot performance of the Mauretania of 4 days 10 hours and 41 minutes for the voyage from Queenstown to New York. The anniversary has been commemorated by the publication of a special brochure illustrating the progress in ocean travel which has been made by the Cunard Company during its eighty years of shipping service.

The Severn Barrage Scheme.

IT is reported that the Severn barrage scheme—a project in which the present Government has expressed much interest as a means of relieving unemployment—is to be investigated closely by experts. A preliminary study has already been made, and is stated to have justified the undertaking of a lengthy investigation. The tidal rise and fall of the river will be observed over a prolonged period, perhaps for a year, as will be the shifting of the sands in the river bed. Trial borings are to be made for the foundations.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. XII.*

ELECTRICAL ENGINEERING EXHIBITS.

SIEMENS BROS. AND CO., LIMITED, WOOLWICH.

Much attention has been paid of late to research work in connection with the temperature of buried cables. Some very valuable results have been obtained, but engineers in charge of distributing systems who desire to arrive at the loading limits of cables have to depend on the results of a series

FIG. 239—CABLE INDICATOR—SIEMENS

of calculations, based on a number of assumptions, concerning the influence of the load on one cable, on the temperature of another cable, and of the thermal resistivity of the soil with varying moisture. This gives rise to a feeling of uncertainty, especially when dealing with extra high-tension cables, and has undoubtedly led in the past to conservative

FIG. 240—CABLE INDICATOR—SIEMENS

ratings, and in some instances to the expenditure of unnecessary capital. Moreover, the introduction of an additional cable in a range of ducts may easily lower the carrying capacity of another cable by an appreciable amount.

But by using the Siemens cable indicator, shown at Wembley and illustrated in Figs. 239 to 242, a continuous watch can be kept on the temperature of any cable, and the rise in temperature due to an overload can either be observed or recorded continuously. A knowledge of the actual temperature of the cables not only sets the engineer's mind at rest, but it also enables him to exercise the utmost economy in connection with the installation of additional feeders. The action of the indicator depends on the change in resistance with increase in temperature of special pilot wires in the cable. These wires may be inserted in the form of small pilot cores, and in a multicore low-tension cable they may take the place of the worming in the centre of the cable. In the case of an extra high-tension cable in which any core in the centre would have to be fully insulated, the wires may be introduced near the lead from which they would only need to be lightly insulated. The actual temperature of the pilot cores would in this case be rather lower than that of the surface of the main conductor, but if desired that can be allowed for in the calibration of the instrument. As will be seen from Fig. 239, the appearance of the temperature indicator corresponds with that of an ordinary voltmeter, but the scale is, of course, designed to give temperature readings instead of electrical pressure readings.

Usually the instrument is provided with a scale of the edgewise type, but other types of scales can be supplied if required. In all cases the indicator is a moving coil instrument, and takes the place of the galvanometer of a Wheatstone bridge, as shown in the diagram of connections—Fig. 241—the special pilot wires in the cable forming the unknown resistance. The other coils of the bridge are generally fitted on the back of a small panel below the indicator. Generally the battery for the bridge consists of a single dry cell which requires no attention, and will last for many months. Battery voltage variations, which, of course, affect the accuracy of the readings are compensated by means of an adjustable rheostat and the test switch, shown in the diagram. To ascertain whether the battery adjustment is correct, the switch lever is moved to the "test" position when the indicator should show a full scale deflection. If it does not do so the rheostat knob is given a turn or two until the full scale deflection is obtained. This test only takes a few moments, and usually it is advisable to make the test daily.

To obtain the temperature of the cable it is merely necessary to move the lever switch—shown on the right of the diagram—to the "on" position, when the temperature can be read directly on the scale of the instrument. By means of additional lever switches it is a simple matter to connect several cables to the same indicator, when the temperatures of all the cables can be taken successively in a few moments. If a permanent record of the temperature is required the makers supply a recorder with a continuous paper chart, which lasts for a period of two months, and on this chart every temperature variation is shown, the chart being driven by an eight-day clockwork mechanism.

If necessary a four colour recorder can be supplied which shows the temperatures of four different cables on the same chart by means of four differently coloured inks. The temperature scales of the indicators and recorders can be calibrated in Centigrade or Fahrenheit degrees, according to requirements, the usual range being 80 deg. to 180 deg. Fah. Generally the pilot wires in the cable are connected in series, and are joined to the indicating apparatus

FIG. 242—CABLE INDICATOR—SIEMENS

by means of ordinary twin copper cable. Variations in the resistance of this cable arising from atmospheric temperature variations will affect the indicator readings, but the error may easily be reduced to a negligible quantity by using a conductor of suitable size.

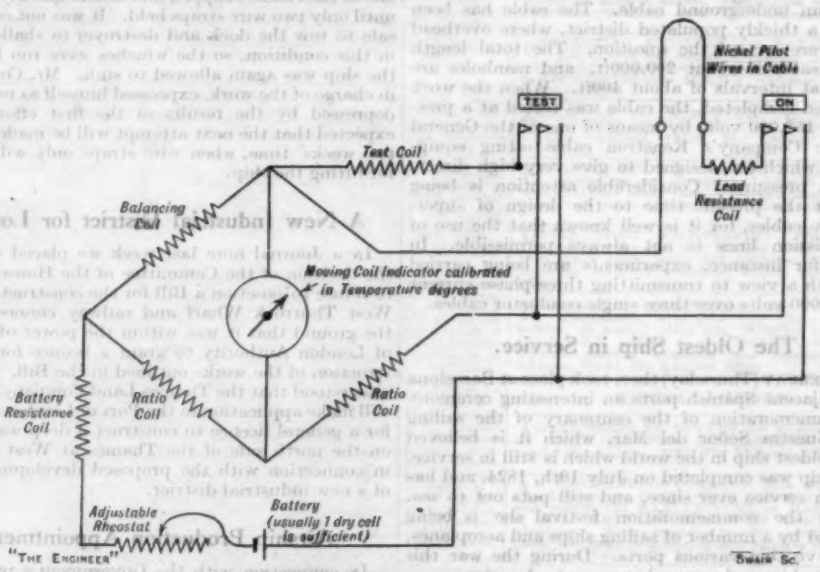


FIG. 241—CONNECTIONS OF SIEMENS CABLE INDICATOR

BRITISH INSULATED AND HELSBY CABLES, LIMITED.

British Insulated and Helsby Cables, Limited, of Prescot, Lancs., are showing, among other things, electric welders for spot, butt and seam welding. A

* No. XI. appeared July 4th.

seam welder fitted with a 10-kilowatt single-phase transformer and designed for belt driving is shown in Fig. 243. A clutch operated by a lever enables the electrode rollers, which are water cooled, to be started and stopped as desired. The movement of the electrodes is intermittent, and the length of feed per revolution may be varied by means of an adjustable stop which controls the ratchet feed pawl. The carrying the top electrode is mounted on a fulcrum which turns in ball bearings, and electrical connection is made to the secondary of the transformer by means of a flexible connection. The bottom stake, it will be noticed, is mounted on a face plate and can be fixed in any desired position. The top arm swivels and the top electrode can be raised or lowered whilst in alignment with the bottom electrode. It is thus possible, the resistance, thus dissipating any charge which may be left in the condenser after it has been disconnected from the supply circuit. As the output of a condenser is dependent upon the voltage and frequency on any given system it is a fixed quantity. If, however, a variable output is required to suit varying conditions of load, the condenser is made in sections, and by means of switches a third, two-

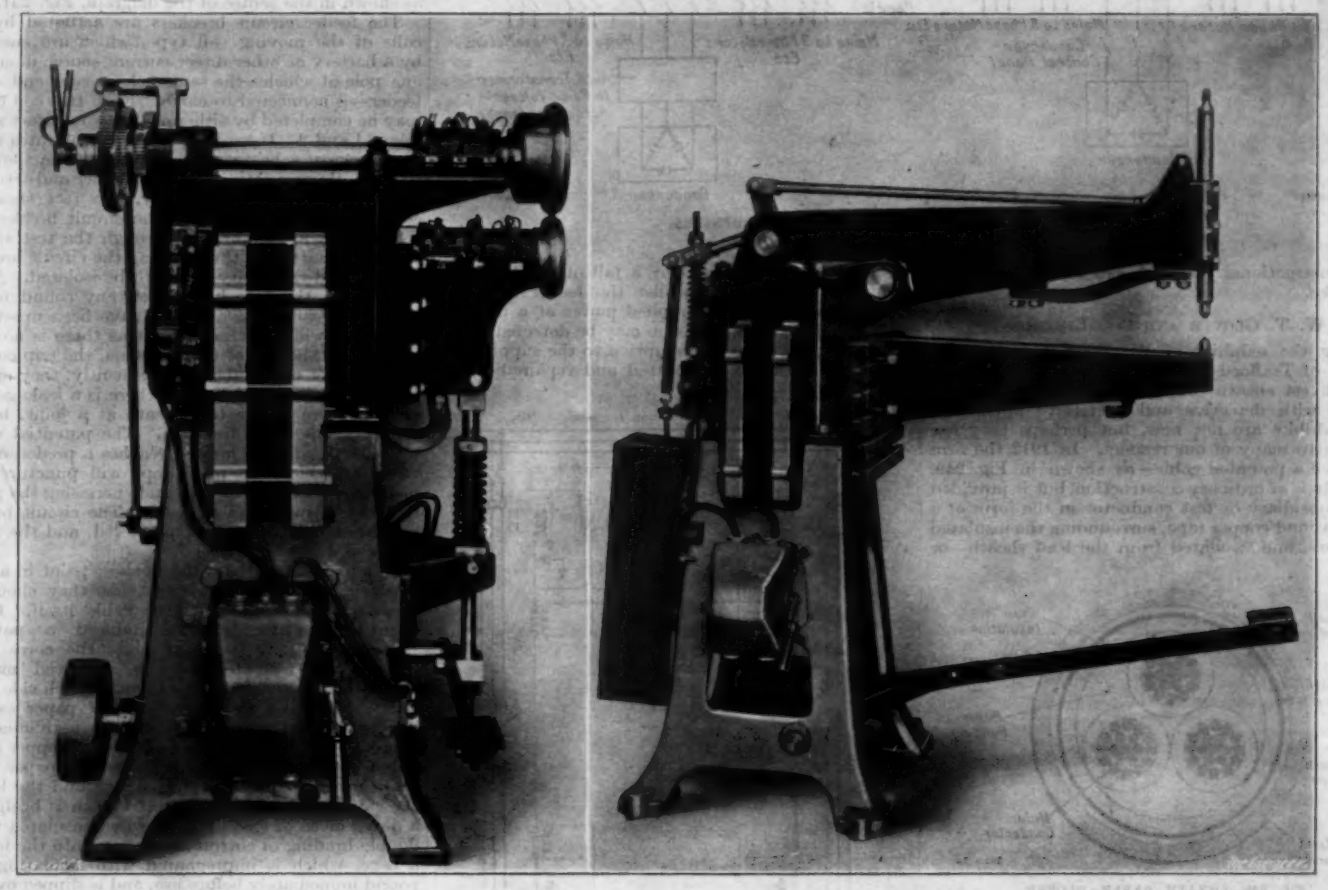


FIG. 243—SEAM WELDER—B. I. AND H. CABLES

FIG. 244—SPOT WELDER—B. I. AND H. CABLES

gear is timed so that when the rollers are stationary the full working current is on, but when the rollers are moving the current is off. An eight-way plug box enables the heat to be varied according to requirements.

A main switch is also fitted for cutting off the current entirely. The mechanical pressure on the

FIG. 245—REACTANCE—B. I. AND H. CABLES

weld is applied by means of springs, which are fitted with an adjusting device to enable the pressure to be varied to suit various thicknesses of metal.

The spot welding machine shown in Fig. 244 is designed for uniting iron and mild steel plates with an added thickness of ¼in., and occasionally up to ½in. Like the seam welder, this machine is provided with a plug box which varies the strength of the current to suit the class of work in hand. The arm by making these adjustments, to make welds in corners and in other places where welding would otherwise present difficulties. This type of welder is made with stakes varying from 9in. to 30in. in length.

The current limiting reactance shown in Fig. 245 is another of this company's exhibits. These reactances are suitable for use on feeder, bus-bar, and generator circuits, and may be used instead of resistances for earthing the star point of generators and step-up transformers. The coiled conductors consist of paper-insulated lead-covered cables, which are cast in concrete, so that short-circuit stresses are taken care of. These reactances will stand the roughest usage and are quite waterproof. As all the live parts are enclosed in metal, which is connected to earth, there is no possibility of anyone receiving a shock. Moreover, as these reactances can stand in open ground, or can even be buried in the ground, it is unnecessary to provide buildings for housing them.

The company's static condensers for the improvement of power factor are on view. The disadvantages of a low power factor are well known to all power station engineers, and to overcome these disadvantages the Helsby static condensers have been evolved. The condensers, which are oil immersed, consist of a number of units—usually 100—which are assembled in a frame, and the required number of these frames for a given circuit are placed in a tank resembling that of a static transformer and as shown in Fig. 246. On high-voltage circuits the required number of frames are connected in series, so that each batch of units in the frame works at the pressure for which it is designed. The method of using these condensers in a three-phase system is extremely simple. The diagram Fig. 247 shows a three-phase condenser connected to a three-phase network for the purpose of improving the power factor. Since, however, the output of a static condenser increases as the square of the voltage applied to its terminals, it is sometimes desirable, in order to reduce the initial cost of the condenser, to use an auto-transformer to raise the condenser voltage, and Fig. 248 shows a scheme of this description.

The condensers are controlled in all cases by means of oil break switches which are fitted with a no-volt coil and an overload release. Each condenser is provided with an ammeter and with auxiliary contacts and resistances, so that when the switch is in the "off" position the condenser is short-circuited through thirds, or the whole of the condenser can be put in circuit. Generally the best position for a condenser is as far away as possible from the generator and as near as possible to the position of the load that gives the low power factor. The reduction of current takes place from the point where the condenser is connected to the circuit, and therefore the losses in the mains

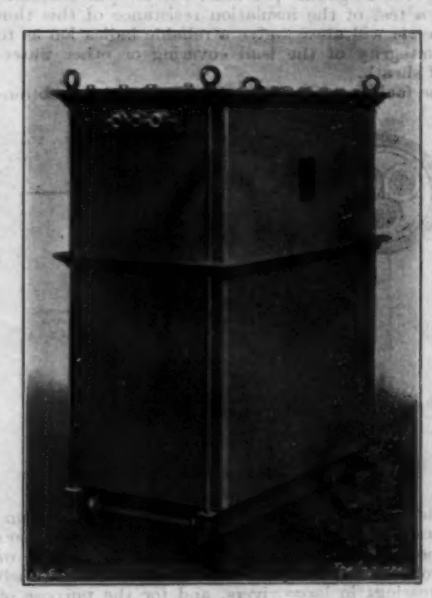
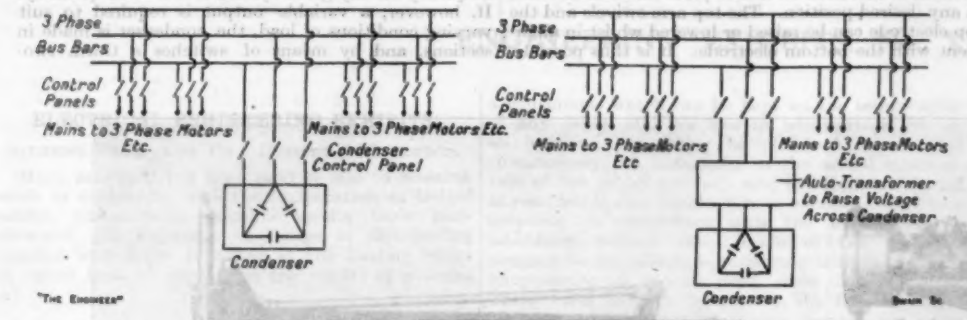


FIG. 246—HELSBY STATIC CONDENSER

and cables between the generator and that point are reduced. Measurements made by the makers' engineers and by independent experts show that the losses in these condensers at ordinary frequencies and temperatures never exceed half of one per cent. There are shown on this company's stand many interesting examples of the cables made by the firm, including examples of super-tension cables for three-phase working at 33,000 to 66,000 volts, all types of

cables for power and lighting purposes, telephone cables, cables for use on motor cars, fine size wires with diameters as small as .001in., trolley wires, enamelled wires, electric railway and tramway over-



FIGS. 247 AND 248—CONNECTIONS FOR STATIC CONDENSERS.

head constructional material, rail bonds, electricity meters, &c.

W. T. GLOVER AND CO., LIMITED.

Among the exhibits of W. T. Glover and Co., Limited, of Trafford Park, Manchester, is the firm's patented test sheath cable, which is shown in conjunction with detective and protective apparatus. These exhibits are not new, but perhaps they are unknown to many of our readers. In 1912 the firm introduced a patented cable—as shown in Fig. 249. This cable is of ordinary construction, but is provided with a subsidiary or test conductor in the form of a spirally wound copper tape, surrounding the insulated conductors, and insulated from the lead sheath—or

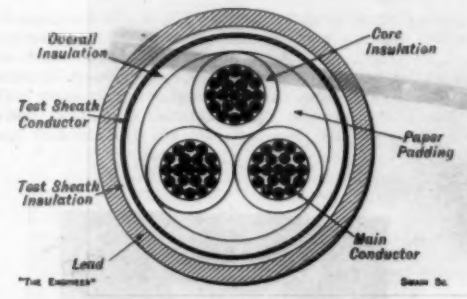


FIG. 249—SHEATH CABLE—GLOVER

from the armour in the case of non-lead covered cables—by a thin layer of insulating material. Any external injury to the cable must obviously entail damage to the insulation of the test conductor before the main insulation is affected. The hygroscopic dielectric between the test conductor is made to withstand the maximum mechanical damage, which is likely to occur during the work of laying the cable, and it has an insulation resistance of the order of 50 to 100 megohms per mile. It is clear therefore that a test of the insulation resistance of this thin dielectric will always give a reliable indication as to the integrity of the lead covering or other waterproof sheath.

The facilities offered by the test sheath for obtain-

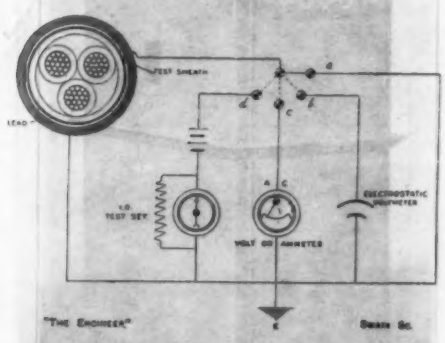


FIG. 250—CABLE TESTER—GLOVER

ing definite information concerning the internal conditions of cables have been utilised by central station engineers for the usual periodical insulation tests of networks and of feeders in vulnerable positions, such as crossings in large rivers, and for the purpose of keeping a constant watch on the condition of cable by testing at any desired moment whilst the cable is alive by means of the detective arrangements—as shown in Fig. 250. These arrangements allow the whole of the dielectric to be explored without the necessity of isolating the cable. Normally, the test conductor is connected to earth, the switch being in the position *a*. By moving the switch to positions *b* and *c* any leakage from the cores can be indicated and measured. If no appreciable leakage exists, movement of the switch to the position *d* enables an insulation resistance test of the test sheath di-

electric to be made, and any exterior damage becomes apparent and can be localised. An incipient fault on a power supply system, discovered by an insulation resistance test, taken in the manner described, has actually been located by a fall of potential test along the test sheath, whilst the feeder remained "alive" and whilst it supplied power at a pressure of 6600 volts. Slight damage may be detected in the initial stages without interruption to the supply, and incipient faults can be located and repaired before

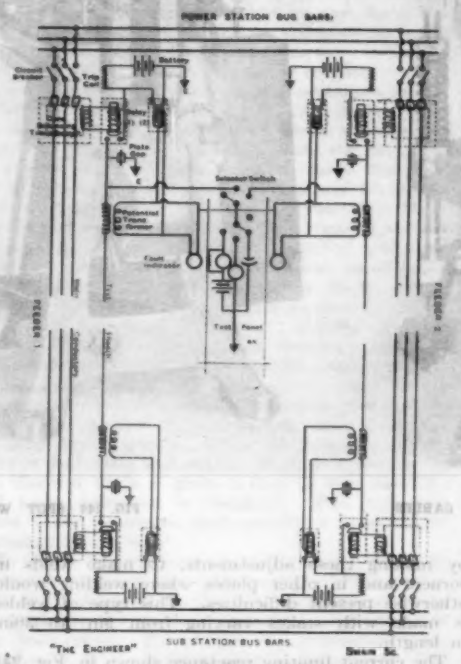


FIG. 251—PROTECTIVE SYSTEM—GLOVER

widespread troubles have been caused by effects secondary to such damage.

A protective system for use with the test sheath type of cable has been developed, and in combination with the detective arrangements referred to is known as Glover's patented detective and protective system. The diagram, Fig. 251, shows the essential parts of the system, and it will be perceived that the protective gear is virtually a combination of leakage and core balance protection. The test sheath is connected at each end to the high-tension side of a potential transformer, having comparatively low ohmic resistance, but high reactance. The other terminal of this transformer is connected to one terminal of a contact maker actuated by an alternating-current relay 1, which is connected in series with the secondary of a core balancing transformer. It is also connected to a plate gap arranged to break down to earth at a predetermined voltage, thus energising the relay 2, and its secondary circuit. At the power-house end it is also connected to a selector switch, making connection with an insulation testing panel—as shown in the centre of the diagram, Fig. 251.

The feeder circuit breakers are actuated by trip coils of the moving coil type, which are energised by a battery or other direct-current source of supply, one pole of which—the same pole at each end of the feeder—is connected to earth. Each trip coil circuit may be completed by either of the two contact maker relays 1 and 2. If external damage penetrates to one of the cores, a heavy current passes from that core to earth, thus upsetting the core balance and actuating the relays 1. Simultaneously, the test sheath is connected to earth, so that the circuit breaker trip coil circuits are completed through the test sheath, earth and batteries, thus causing the circuit breakers to open and the faulty feeder to be isolated. At the same time, the core balance on any sound feeders supplying load in parallel will have been upset, and the relays will be actuated, but as there is no earth on the test sheaths of these feeders, the trip coil circuits are not completed; consequently, they are not energised. Assume now that there is a leakage from any one core to the test sheath at a joint, but no connection is made to earth. The potential of the test sheath will rise until it reaches a predetermined value, at which the plate gaps will puncture, thus making connection to earth and energising the potential transformers and relays 2. The circuit breaker trip coil circuits are thus completed, and the faulty feeder is isolated.

Joints are admittedly the weakest point in a cable network, and it is important that they should be sheathed as efficiently as the cable itself. Consequently, the firm has introduced a patented "sheathed" joint, which enables the cores to be jointed and insulated in any approved manner. The copper test sheath tape is cut on each side of the joint, so as to leave about 1in. of paper exposed between it and the point where the individual conductors are splayed out. About 1in. of copper sheath is left bare and about another inch of paper is left between this exposed copper sheath and the lead of the cable. The gap in the test sheath is bridged by a dozen or so of small copper wires, insulated with a double brading of cotton and woven into the form of a cage, which is impregnated with insulating compound immediately before use, and is slipped over the cable before the conductors are joined. When the jointing operation is complete the cage is bound down and sweated at one end.

The cage is then adjusted to give the correct clearance round the conductors, and the wires are bound down at the other end and surplus wires are trimmed off. Finally, the sleeve is placed in position over the joint, and is plumbed and filled in the usual manner. With this form of construction, the electrical continuity of the test sheath is efficiently maintained across the joints. The main current carrying conductors are also entirely sheathed by the test conductors at joints, and there is no obstruction to prevent the compound flowing freely round and into all interstices of the joints.

ELLIOTT BROTHERS (LONDON), LIMITED.

The Thomas averaging recorder—which is illustrated in Fig. 252—is being exhibited by Elliott Brothers,

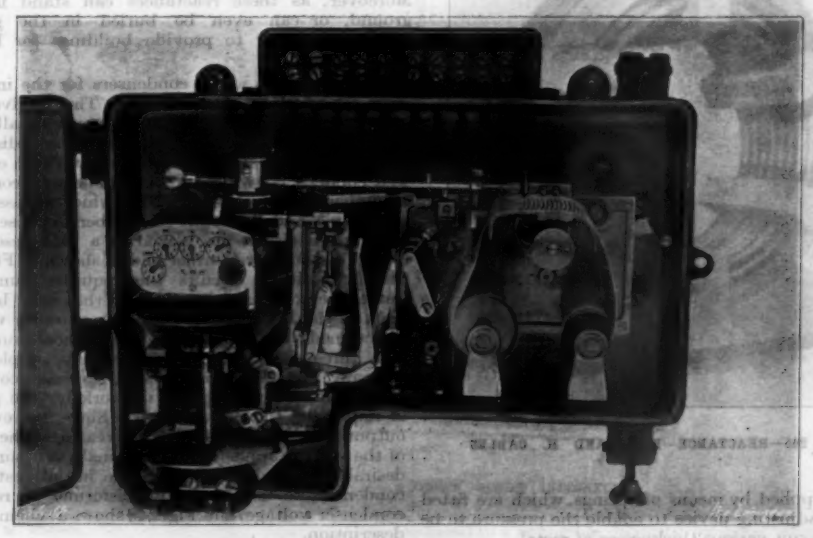


FIG. 252—THOMAS AVERAGING RECORDER—ELLIOTT BROTHERS

of Central Buildings, Westminster. It is pretty generally recognised that in the charge made for electric power account should be taken of the maximum demand on the system. The Thomas averaging

recorder has been designed with a view to measuring the maximum demand in a manner that is fair to the consumer and to the supply authority. It is a combination of integrating and graphic recording instruments, designed to give the total kilowatt hours up to the time of reading, and a graphic record of the maximum demand averaged over some agreed time interval. To take the peak reading of the demand would in most cases be unfair to the consumer, for in the majority of instances the peak is practically instantaneous or lasts perhaps a few seconds. Peak loads of this kind can be dealt with by the fly-wheel effort of the plant. But when the peak load lasts for a minute or more, an excess demand over the consumer's normal load is called for, and the duration of the peak has a marked influence on the running plant and boiler capacity at the station.

The averaging recorder under consideration can be arranged for periods of 2, 3, 5, 10, 15, 20, 30, 45 or 60 minutes. The recorder illustrated is for a three-phase, three-wire unbalanced load circuit, and the graphic portion has a time period of 30 minutes. Standard current windings are designed for 5 ampères and potential windings for 110 volts. The instruments are intended to work with current transformers, and, if necessary, they can have self-contained potential windings for pressures up to and including 600 volts. The integrating portion of the instrument consists of a standard integrating meter, with an additional spindle, which projects upwards. At the top of this spindle there is an ingenious magnetic clutch, which consists of a disc of mild steel, on which a small bar magnet rests, and as the disc is rotated by the meter elements, the magnet and marking pen attached to it move forward.

At the end of the definite time period, the clockwork which pays forward the paper chart releases a cam, which allows a glass disc to rotate between a pair of contact fingers, until the fingers make contact through a gap cut in the glass. An electro-magnet is then energised, thus attracting an armature, which brings the marking point of the pen into contact with the chart, and a fraction of a second later it returns the pointer to zero, thus drawing a line across the chart, re-setting the recorder for the next time period, and opening its own circuit. It will be observed that until the pointer is acted upon by the electro-magnet, the pen is not in contact with the chart, so that the accuracy of the metering portion is unaffected.

GENERAL ENGINEERING EXHIBITS.

HENRY SIMON, LIMITED.

The firm of Henry Simon, Limited, Manchester has working exhibits of grain cleaning and flour milling machinery in the Palace of Engineering. A machine which is not yet as well known in this country as it deserves is the Carter disc separator, for extracting oats, barley, cockle, and small seeds from wheat. This machine can perform the work which usually requires several machines, and only occupies a floor space of 6ft. by 4ft. for an output of 200 bushels per hour. The machine is self-contained and the power required for its operation is not more than 2 horse-power. Essentially, it consists of a series of chilled cast iron discs mounted closely together on a horizontal central shaft and enclosed in a dust-tight metallic casing—as shown in Fig. 253. The faces of the discs are indented with many hundreds of small pockets, which are undercut so as to retain the grain or seeds that are to be removed—as shown in Fig. 254. The grain enters the head end of the machine, through a feed hopper, and the discs revolving at a moderate speed through the grain pick up the wheat and reject barley, oats and other material longer than wheat. Of course, the discs can be constructed to suit special requirements, such as the separation of rice, coffee, &c. Blades on the centre of each disc act as a screw conveyor which forces the rejected grain from one disc to another until after a searching separation it is finally tailed away at the end of the machine. The grain, lifted by the pockets, falls into troughs arranged between each pair of discs, and passes out of the machine through the bottom hopper. A valve is placed at the tail end of the machine and another at the inlet end, and these valves give complete control over the operation of the machine. Another machine is shown by Henry Simon, Limited, in operation in the Burmah section. It is called a Paddy eliminator,

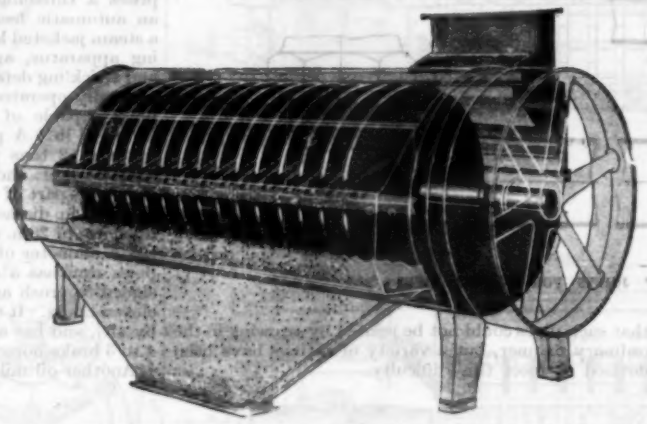


FIG. 253—CARTER DISC GRAIN SEPARATOR—HENRY SIMON

and is designed specially for use on rice plantations. It operates on the shaking principle. By the introduction of this appliance, the percentage of whole grains obtained in milling by reducing the amount of breakage made in the shelling process has been materially increased. The separation is effected on the basis of the specific gravity of the grains treated. The unshelled grains being of a lower specific gravity than those that are shelled, are shaken to the top, the heavier shelled grains falling to the bottom of peculiarly shaped compartments or chambers. Suitable outlets are provided at either end of the chambers. The body of the machine is mounted on trunnions, and is made to oscillate by means of a crank on the pulley shaft, and the angle of the floor of the machine can be adjusted as required.

In connection with the Manchester Ship Canal Company's exhibit, in the water transport section, Messrs. Simon have supplied excellent models of the grain elevators which have been erected by them at the Salford Docks.

COCHRAN AND CO., LIMITED.

On the stand of Cochran and Co., Limited, of Annan, Scotland, there are shown examples of the largest and the smallest of the twenty-two stock sizes of the firm's well-known design of horizontal flue tube vertical boiler. The original Cochran boiler was designed by Mr. Edward Crompton in 1878, and at the South Kensington Museum a memento of it is to be found in the form of the inventor's preliminary sketch showing its essential features. Nearly ten thousand of these boilers have now been built, but the general features of the design have remained unaltered since the first was made, except for the introduction of such details as a patented seamless furnace and a hemispherical instead of a flat top to the outer shell. The larger of the boilers shown by Messrs. Cochran has a diameter of 8ft. 6in. and a height of 17ft. It has a heating surface of 1000 square feet, and under normal conditions with good fuel is rated by the makers to evaporate, without being forced, 7500 lb. of water per hour for a fuel consumption of only 1000 lb. These figures, it is claimed, can be maintained indefinitely and be excelled for short periods. The efficiency of the boiler is preserved by the ease with which every part of the interior is made accessible for examination and cleaning. The arrangement of the flue tubes horizontally is also claimed to promote efficiency. Combustion is effected within a hemispherical furnace chamber, from which the products pass into a brick-lined chamber attached to the inner side of the boiler shell. The gases pass from this chamber through the horizontal tubes to a similar chamber on the opposite wall of the shell, and thence escape to the atmosphere by way of an attached chimney. It is claimed that with this form of boiler the danger of overheating has been eliminated. The boiler is suitable for either land or marine work. At the Exhibition, an example is to be found at work outside the Burmese section, working an oil shale distillation plant. In the same section a sectional model is shown designed for firing with paddy husk, while another model fitted for oil fuel firing is being shown on the stand of the Wallsend Slipway and Engineering Company.

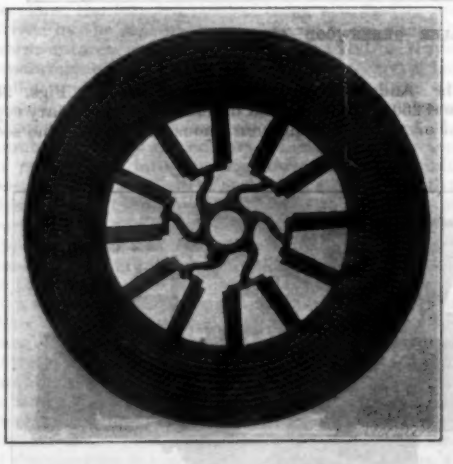


FIG. 254—CARTER GRAIN SEPARATOR DISC

NON-FERROUS METALS.

An imposing display has been arranged on a large stand by the Brass, Copper and Nickel-silver Trades of Great Britain, and includes examples of the products of some eighty firms, ranging from such small domestic articles as hooks and eyes up to large condenser tube-plates and fire-boxes. Part of the stand is also devoted to the research work carried out by the associated manufacturers, and that part of the exhibit will probably be of the greatest interest to engineers, as the products are generally familiar, although some of the examples shown are quite exceptional in one way or another.

In connection with the research work, some excellent little booklets have been prepared, and give the physical characteristics of the metals concerned. The graph shown in Fig. 255 has been prepared from one of these publications, and is noteworthy, as it includes a curve of comparatively recent introduction. This diagram indicates the changes in the physical properties of brass on annealing, and besides the usual tensile and hardness tests, includes the results of what is known as the tear-length test. For the purposes of this test, two parallel cuts, 1 cm. long and 1 cm. apart, are made in the edge of a thin strip of the metal. The tongue of metal thus formed is turned up at right angles to the surface of the strip and pulled in that direction, while the strip is tightly held. As the cuts extend, in the form of tears, they converge, and a triangular piece of metal comes away. The length of the triangle is taken as the tear-length. For hard-rolled strip the length is generally short, say, 1 cm. or 2 cm., but with soft annealed strip, the tear-length may be more than 6 cm. The graph shows very plainly that the tear-length across the strip or at right angles to the direction of rolling remains comparatively short, while, when made along

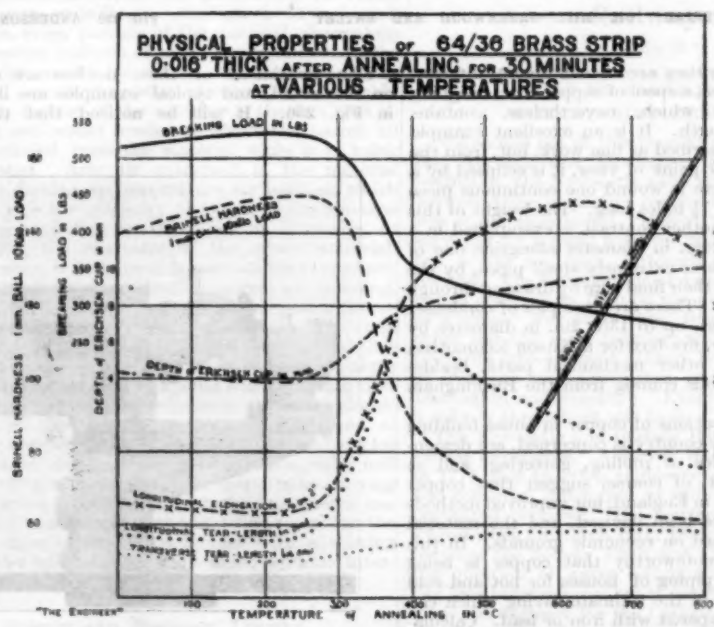


FIG. 255—CURVES SHOWING CHANGES IN THE PHYSICAL PROPERTIES OF BRASS AFTER ANNEALING

the strip, the length is affected very materially by annealing. It will also be observed that the tear-length curve closely follows that for longitudinal elongation under stress.

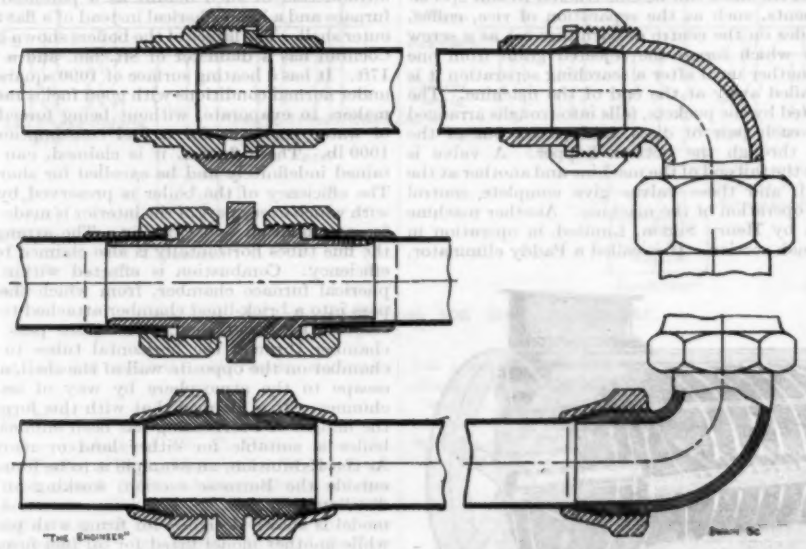


FIG. 256—TYPICAL EXAMPLES OF JOINTS FOR COPPER PIPES

It would be impossible, in the space at our disposal, to catalogue the various examples of work shown on this stand, and it is difficult to settle on any one for special comment, as they are of such diverse interest. There is, for instance, a spool of copper wire, weighing only 16¼ oz., but which, nevertheless, contains 20 miles in one length. It is an excellent example of what may be described as fine work, but, from the practical engineer's point of view, it is eclipsed by a drum on which there is wound one continuous piece of ⅛in. copper wire 7½ miles long. The weight of this coil is 2120 lb. Another contrast is exemplified in a solid-drawn tube 24in. in diameter alongside one of capillary bore. These extremely small pipes, by the way, are reduced to their final bore by drawing through a die just like wire. There are examples of condenser tube plates, in brass, up to 13ft. 2in. in diameter by 1in. thick, a copper fire-box for a Kitson locomotive, and a number of other mechanical parts, besides light household goods coming from the Birmingham district.

Some new applications of copper in house-building work, so far as this country is concerned, are demonstrated in examples of roofing, guttering, and so forth. We do not, of course, suggest that copper roofing is a novelty in England, but improved methods of application have been devised, and the material is being put forward on economic grounds. In this connection, it is noteworthy that copper is being advocated for the piping of houses for hot and cold water, on account of the ultimate saving which can be effected, as compared with iron or lead. Calculations made by the Association show that the annual cost over the life of a house pipe system are in the ratio of 126 for iron, 114 for lead and 85 for copper. In order to secure this advantage in the use of copper, it is naturally necessary to keep the pipe as light in gauge as is consistent with the stresses to which it will be subjected in service, and tube of about No. 20 gauge is recommended in the case of ½in. bore. Such a pipe, solid drawn, will withstand an internal pressure of about 5000 lb. per square inch. It is obvious that such pipes could not be jointed by screwing in the ordinary manner, but a variety of fittings have been devised to meet this difficulty.

Some specimens of these devices are exhibited on the stand, and typical examples are illustrated in Fig. 256. It will be noticed that the joints can be made with quite simple tools, and that a clear passage for the flow of the water is provided in each case.

GREENWOOD AND BATLEY, LIMITED.

The small Anglo-American oil mill illustrated in Fig. 257 is represented on the stand of Greenwood and Batley, Limited, Albion Works, Leeds. Small mills of this class are intended particularly for use in inland districts to which access may be difficult, and, as a consequence, every effort is made to attain portability in the design. In the "Imperial" mill illustrated, no single part exceeds 2¾ cwt. in weight. Simplicity of construction and assembly is also a very desirable feature, for the skilled labour available for re-erection on the site may be deficient in quality or quantity. In this respect, the item of the foundations required is an important one, for it is one over which the makers can have no control by previous erection. In the present instance, the whole of the plant is carried on two steel girders, and beyond sinking a few wooden beams in the floor at the site, no foundation work is necessary. The plant comprises a three-high end roll with a hopper having an automatic feeding arrangement embodied in it, a steam jacketed kettle provided with a meal-moistening apparatus, agitating gear, and meal-measuring and strickling details, a cake-moulding machine of the manually operated screw press type, and a plate oil press capable of taking ten cakes, each weighing about 2½ lb. A pump supplying the oil press with water at 2 tons per square inch, a cistern for the supply water, and a cake-stripping and paring table also form part of the equipment. The crushing rolls are 8in. in diameter by 8in. long, the kettle has a diameter of 20in. and a depth of 14in., the pump ram has a diameter of ¾in. and a stroke of 3in., and the press ram has a diameter of 6in. The plant is designed to crush and press about 10 cwt. in a day of eleven hours. It occupies a floor area of only 6ft. 3in. by 4ft., and has an overall height of 4ft. 6in. About 4 to 5 brake horse power is required to drive the mill.

Another oil mill appliance exhibited by the firm is the Anderson oil expeller, illustrated in Figs. 258 and 260. This machine differs from the ordinary type of oil press in being continuous in action. The seed can be pressed cold and without preliminary crushing, although naturally the best results are obtained by rolling and heating it before passing it into the

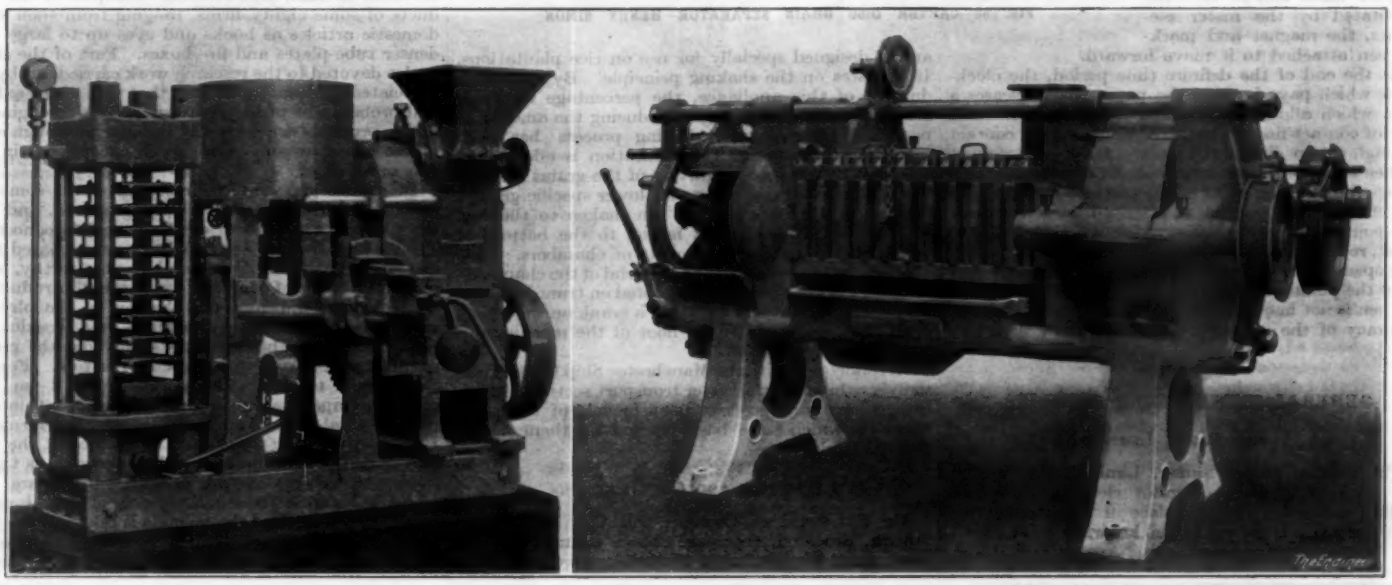


FIG. 257—"IMPERIAL" OIL MILL—GREENWOOD AND BATLEY

FIG. 258—ANDERSON OIL EXPELLER—GREENWOOD AND BATLEY

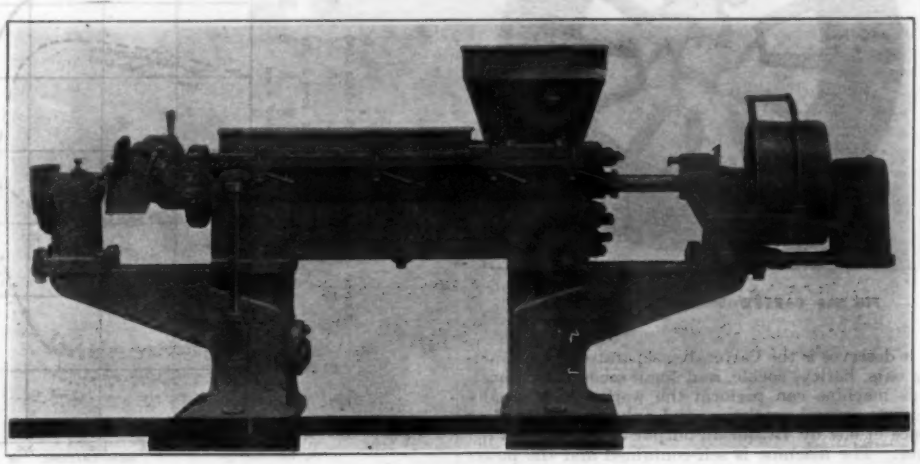


FIG. 259—THE "ATOMIKER"—GREENWOOD AND BATLEY

expeller. To this end a tempering apparatus can be supplied for attachment directly above the machine, but in our engravings this addition is not shown. The Anderson expeller, we are informed, is in extensive use for the first pressing of copra, both in this country and overseas, and of that material it is capable of dealing with 4 cwt. to 5 cwt. an hour. The machine, as shown in the general arrangement drawing, is driven from a back shaft provided with a belt pulley and friction clutch. From this shaft power is transmitted through double reduction gearing to a central shaft carrying a worm. The central shaft runs at eleven revolutions per minute, and is provided with radial and thrust ball bearings. The worm is in two portions, the forward portion being attached to and driven by the central shaft. The rear portion of the worm rotates on the central shaft, and is driven separately at 17 revolutions per minute by a belt pulley and gear wheel drive, originating from the second motion shaft of the main drive. The worm rotates within a circular sectioned cage, formed of a number of closely spaced bars of hard steel. The seed or meal is fed into the cage down a vertical inlet passage at the rear end of the worm, and the fact that this portion of the worm runs faster than the forward portion results in a high degree of compression being applied to the material. The exact amount of the final pressure is regulated by means of a cone device at the outlet end of the cage. This cone is mounted on a screwed sleeve and rotates with the central worm shaft. It can be moved along that shaft so as to vary the area of the annular opening at the outlet end of the cage by means of a gear wheel attached to it, and meshing with a long pinion shaft. When it is desired to adjust the cone to give a smaller opening, the machine is stopped and a crank handle is placed on the end of the pinion shaft. A pin on the end frame of the machine is then drawn out to act as a stop to the crank handle, and the machine is started up. When the desired adjustment of the cone has been effected, the machine is stopped and the crank handle removed. To facilitate the lifting up of the top half of the cage for inspection or cleaning purposes, a small pulley with an attached chain is fixed on one of the top longitudinal stays. The chain is hooked to the cage and a ratchet lever is attached to the pulley spindle. A second ratchet in the pulley maintains the load when the pull on the lever is released.

A machine on the same stand of very great mechanical interest and of wide industrial application is the "atomixer"—Fig. 259. As the name suggests, this machine is intended to effect the intensive, intimate mixing or incorporation of liquid or semi-liquid materials, pastes or emulsions. Inside a barrel, which is jacketed for heating or cooling, there rotates a shaft on which are mounted two series of vanes of a special patented type. The vanes are of stream-line form. One series imparts a forward movement to the material, while the other imparts a backward. The vanes of the two series are equal in number, but the two sets by accurate machining are made different to an extent varying from $\frac{1}{16}$in. to $\frac{1}{200}$in., according to the speed of the shaft, and in such a way as to cause the forward movement of the material to be in excess of the backward. The smallest machined difference may be associated with a speed of 5000 revolutions per minute. By varying the speed and the machined difference, the output can be varied between very wide limits. At high speed and small difference, every particle of the material, the makers state, receives millions of blows per minute from the vanes, the action of which is characterised as "terrific"—no doubt justly. A subsidiary but highly important feature of the machine is the fact that as the inlet and outlet levels are above the barrel, all air is excluded from the material while it is being incorporated. Any air entrained in the material would be divided up into minute air bubbles, which would reduce the efficiency of action of the machine by acting as buffers to the blows or otherwise, or would alter the character of the mixed material. The atomixer, it is claimed, is very suitable for effecting difficult emulsions or for high degree wet grinding. It is in use in the chocolate trade for tempering chocolate just before it is moulded. The intensive mixing, combined with the quick cooling of the material that can be secured by means of the machine—in three minutes, it is stated, as compared with a normal time of about twenty minutes—imparts various desirable qualities to the finished product. At a speed of 300 to 500 revolutions, the machine has been used for converting relatively dry material from a roller mill into a homogeneous paste. In most trades mixing is still a batch process, but with the atomixer it can be made continuous by providing containers for the separate ingredients and a hopper with a stirring device from which the machine is fed without intermission.

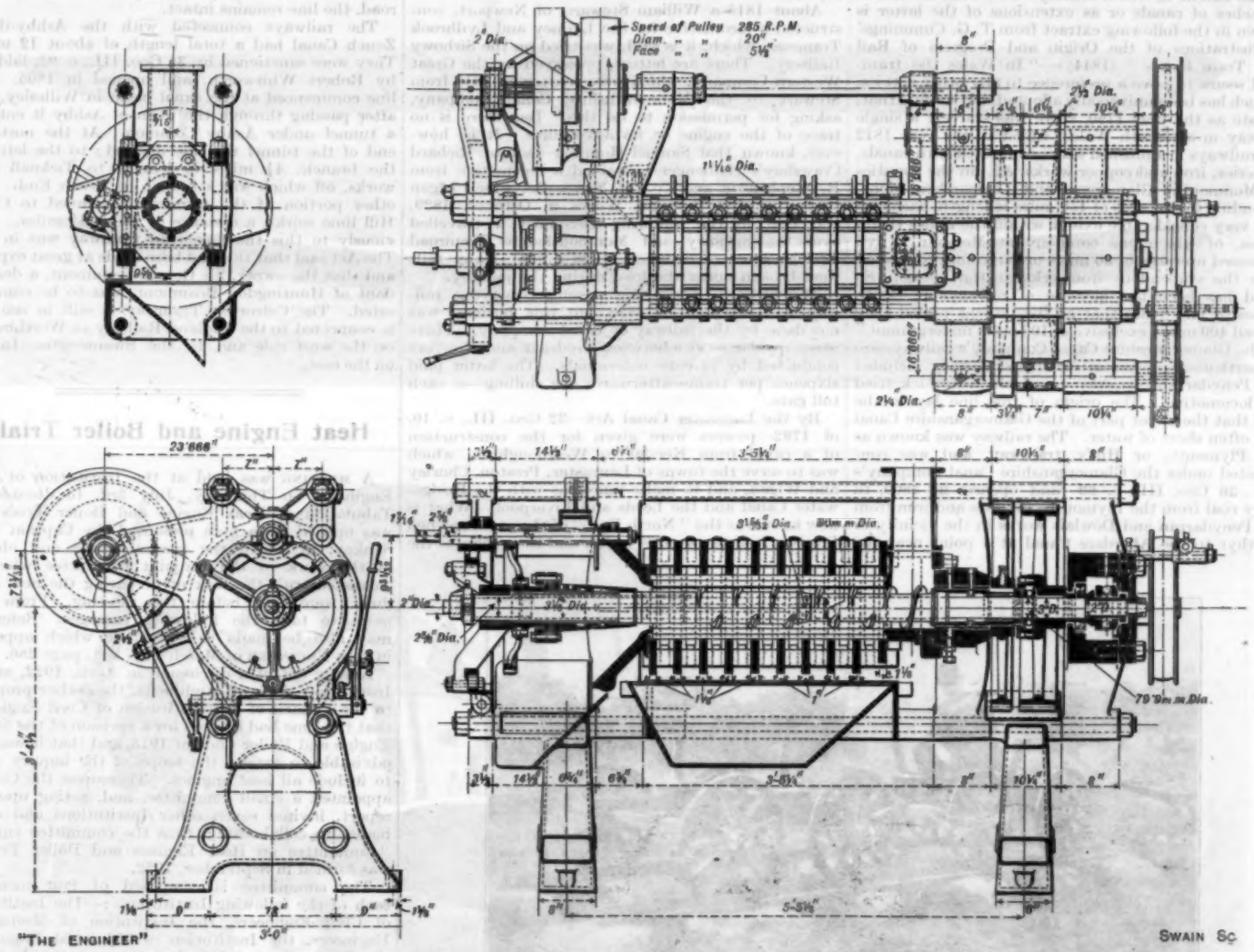


FIG. 260—ARRANGEMENT OF ANDERSON OIL EXPELLER—GREENWOOD AND BATLEY

RUSTON AND HORNSBY, LIMITED.

In our issue of May 2nd we gave a description of the heavy oil engine exhibited at Wembley by Ruston and Hornsby, Limited, of Lincoln, and published a line drawing, illustrating its general arrangement. We are now able—on page 46—to give an engraving of the set, as it actually appears in the Exhibition where it is used to supply part of the current used in the Palace of Engineering. The illustration shows the excentric valve operating gear very plainly, while the group of four fuel valves can be seen in front of the left-hand cylinder. In conversation with the adjacent stall holders, we received a good testimonial to the quiet running of the engine, none of them having the least complaint as to noise or vibration, although it is on load practically all day long.

One Hundred Years of British Railways.

No. II.*

PART I.—THE STOCKTON AND DARLINGTON RAILWAY AND ITS PREDECESSORS.

RAILWAYS SUPPLEMENT CANALS.

WE should not at this time be thinking so much of the Stockton and Darlington Railway nor of its neighbour, the Newcastle and Carlisle, had the canals between those respective centres been constructed as was at one time hoped. Robert Whitworth, in 1768, surveyed for a canal between Winston and Stockton, but it was not built, although the idea was often revived. The first mention of a railway between these points occurred in 1810 on the question of a railway or a canal. For some time, first one and then the other was the more popular, and at one period the favourite scheme was a railway between the collieries at Winston and Darlington and a canal between Darlington and Stockton. Eventually, as is known, a railway throughout was built.

The Newcastle and Carlisle Railway had almost a similar experience. A survey was made by Smeaton in 1778, and by other engineers in subsequent years, but continual differences of opinion as to the route prevented progress. The matter, however, reached a head when on March 12th, 1823, a canal was opened between the Solway Firth and Carlisle. Interest in the question of water communication between the two seas became keen, but it was damped when Chapman, the engineer for the Carlisle canal, pointed out the superiority of the railway. The latter eventually won the day, and the Act received the Royal Assent on May 22nd, 1829. The line was of the then unprecedented length of 61 miles.

Another illustration of how canals influenced rail-

* No. I. appeared July 4th, 1924.

ways may be seen in the Liverpool and Manchester Railway, as its inception was mainly the result of the arrogance and independence of the owners of the waterways between the two cities. But the prosperity of the many canals brought support to the railways, for speculators thought that similar results would come to them.

The extent to which railways were built instead of branches of canals or as extensions of the latter is shown in the following extract from T. G. Cummings' "Illustrations of the Origin and Progress of Rail and Tram Roads" (1844):—"In Wales the tramroad seems to have a preference to any other species, as such has been universally adopted, but we find that, as late as the year 1790, there was scarcely a single railway in all South Wales, whilst in the year 1812 the railways in a finished state, connected with canals, collieries, iron and copper works, &c., in the counties of Monmouth, Glamorgan and Carmarthen alone, extending to upwards of 150 miles in length, exclusive of a very considerable extent within the mines themselves, of which one company at Merthyr Tydvil possessed upwards of 30 miles underground connected with the stupendous ironworks at that place. So rapid has been the increase of railways in South Wales of late years that at the present period they exceed 400 miles, exclusive of 100 miles underground."

The Glamorganshire Canal Company's railways are of particular interest in one respect—they included the Penydarran tramway on which Trevithick tried his locomotive. The origin of this line lay in the fact that the upper part of the Glamorganshire Canal was often short of water. The railway was known as the Plymouth, or Hill's, tramway, and was constructed under the Glamorganshire Canal Company's Act—36 Geo. III., c. 69—and opened in 1800, to carry coal from the Plymouth collieries and iron from the Penydarran and Dowlais works in the vicinity of Merthyr to the Aberdare Canal at a point near the

FIG. 1—RAILS AND WAGONS, PLYMOUTH OR HILL'S TRAMWAY, 1800

present Abercynon Station of the Taff Vale Railway—formerly known as Aberdare Junction Station—a distance of 9 miles parallel with the canal. This tramway remained in use until the year 1875, and the rails were taken up in 1890. When the World's Columbian Exhibition was held in Chicago in 1893 the Plymouth Company sent ten of the rails and two of the original wagons to it. Fig. 1 is a reproduction of a photograph of these.

The Middleton tramway mentioned in our first article has not only the distinction of being the first railway to receive parliamentary sanction—in 1758—but Middleton Colliery was where John Blenkinsopp worked as a viewer, and it was on the Middleton tramway that his engine was tried in 1811. The next Act to sanction a railway was that—16 Geo. III., c. 32, of 1776—of the Trent and Mersey Navigation from Froghall to the limestone quarries at Caldon.

In 1802, by 42 Geo. III., c. 115, four separate interests were given powers to make railways. That Act sanctioned:—(1) The formation of the Sirhowy Tramroad Company and empowered it to make a railway from Sirhowy furnaces to Nine Mile Point; (2) the Monmouthshire Canal Company to make a railway from Nine Mile Point to a spot to be determined by Sir Charles Morgan—afterwards the first Lord Tredegar—on the west side of Tredegar Park, and from a point, similarly determined, on the east side of the estate to the Monmouthshire Canal. The Canal Company was also to build a line from Risca to Crumlin, there to join the line thence to Beaufort and Sirhowy; also a line from Court-y-Billa to near Pill-Gwnelly; (3) Sir Charles was to make the railway, one mile in length, across Tredegar Park—known to this day as the Tredegar Park Mile. In addition to these, powers (4) were given to Samuel Homfray—who challenged Richard Crawshay for £1000 as to the ability of Trevithick's locomotive to take a load of iron from his works to the canal, 9 miles distant—and others to make a railway from near Tredegar ironworks to the limestone quarry at Trevil, and one from near Nantybwch to the Union Ironworks in Rumney. The distance from Newport to the Sirhowy furnaces was 24 miles. A peculiar feature of the 1802 Act was the provision that the Canal Company, the Sirhowy Tramroad and Sir Charles Morgan, were each authorised to repair the other parties' railway should it be out of repair.

About 1815 a William Stewart, of Newport, constructed a locomotive for the Lydney and Lydbrook Tramroad which, it is said, was tried on the Sirhowy Railway. There are letters, preserved by the Great Western Company, which were written in 1816 from Stewart to the Monmouthshire Canal Company, asking for permission to do this. But there is no trace of the engine or its adventures. It is, however, known that Samuel Homfray—son of Richard Crawshay's challenger—obtained a locomotive from R. Stephenson and Co., of Newcastle, which began to run at the Tredegar Works in October, 1829, and that in the following December it travelled over the Sirhowy and Monmouthshire Tramroad into Newport, a distance of 28 miles. Many rails were broken under the load during the journey.

The Sirhowy was a big passenger-carrying railway as long ago as 1822, but this business was not done by the railway or canal company. There was a regular service between Tredegar and Newport conducted by private individuals. The latter paid sixpence per tram—afterwards one shilling—at each toll gate.

By the Lancaster Canal Act—32 Geo. III., c. 10, of 1792—powers were given for the construction of a canal from Kendal to Westhoughton, which was to serve the towns of Lancaster, Preston, Chorley and Wigan, and to make junctions with the Bridgewater Canal and the Leeds and Liverpool. What is now known as the "North End" of the canal reached Preston, a distance of 60 miles, and then there is the gap of 5 miles to Walton Summit, where begins the "South End" which runs for 14 miles to Kirkless Top Lock near Wigan. This gap was filled by the Preston and (Walton) Summit Tramroad, which was constructed because the canal company could not finance the building of an aqueduct across the river Ribble.

The railways of the Derby Canal Company are of interest for two reasons. They were sanctioned by 33 Geo. III., c. 102, and were built under the direct influence of Benjamin Outram—who, with William Jessop and Frederick Wright, had founded the Butterley Company in 1790—and they were in use until quite recently.

Traffic ceased in 1908, and the rails were taken up in 1913. Many of the stone sleepers were left in the road, and when the present writer inspected the route in the spring of 1924 he saw some of the sleepers being removed.

The Peak Forest Canal lies between the Macclesfield Canal and the Ashton Canal, all three of which, in the forties, passed into the hands of the Manchester, Sheffield and Lincolnshire—afterwards the Great Central—Railway. The Peak Forest Canal and the construction of railways or stone roads from Chapel Milton to Loads Knowl were sanctioned by 34 Geo. III., c. 26. Proprietors of mines of coal or stone or of furnaces or other works were authorised to make branches of not more than 2000 yards in length. The railway begins at the canal at a point near the Bugsworth Station of the Midland Railway, and is 6 miles in length and double throughout. In this distance it reaches an elevation of 1139ft. above Ordnance Datum. The first three miles have a gradient of 1 in 80 rising, and then, at Chapel-en-le-Frith, there is an inclined plane, about 520 yards long. It begins on a gradient of 1 in 8½, ends with 1 in 6½, and rises 209ft. From the top of the incline to the end of the line the railway rises 206ft. by a gradient of 1 in 60.

The gauge of the Peak Forest Tramway is 4ft. 2½in. and the road is laid on stone sleepers. Originally, the line, which was laid out by Outram, had cast iron plate rails 3ft. long and weighing 56 lb. per yard. About 1870 these were replaced by steel rails of the same pattern and of the same weight but 9ft. and 12ft. in length. They were rolled in the locomotive shops at Gorton. Whilst there is, at the time of writing, practically no traffic over the road, the line remains intact.

The railways connected with the Ashby-de-la-Zouch Canal had a total length of about 12 miles. They were sanctioned by 34 Geo. III., c. 93, laid out by Robert Whitworth, and opened in 1805. The line commenced at the canal basin in Willesley, and after passing through the town of Ashby it entered a tunnel under Ashby Common. At the northern end of the tunnel the line divided; to the left ran the branch, 4¼ miles in length, to Ticknall lime works, off which was a branch to Heath End. The other portion of the tramway continued to Cloud Hill lime works, a distance of about 4¼ miles. Previously to this the Coleorton tramway was in use. The Act said that this had been made at great expense and that the owner, Sir George Beaumont, a descendant of Huntingdon Beaumont, was to be compensated. The Coleorton Tramway is still in use and is connected to the Midland Railway at Worthington on the west side and to the Swannington Incline on the east.

Heat Engine and Boiler Trials.

A MEETING was held at the Institution of Civil Engineers on Thursday, July 3rd, to discuss the Tabulation of Heat Engine and Boiler Trials. It was opened by a note presented by Captain Riall Sankey, in which the general scope and objects of the work of the conjoint committee which is entrusted with the task of preparing the new schedules were laid before the meeting. From this note we take the following passages. Reference may also be made to an article which appeared in THE ENGINEER of March 14th last, page 286.

Arising out of a discussion in April, 1922, at the Institution of Naval Architects, the author proposed to the Council of the Institution of Civil Engineers that the time had arrived for a revision of the Steam Engine and Boiler Code of 1913, and that it was also advisable to extend the scope of the inquiry so as to include all heat engines. Thereupon the Council appointed a small committee, and, acting upon its report, invited seven other Institutions and other bodies to collaborate; thus the committee entitled "Committee on Heat Engines and Boiler Trials" was formed in September, 1922.

The committee is composed of four members each of the following Institutions:—The Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institution of Naval Architects, the Institute of Marine Engineers, the North-East Coast Institution of Engineers and Shipbuilders, the Institution of Engineers and Shipbuilders in Scotland, the Institute of Chemistry of Great Britain and Ireland, and the Institution of Gas Engineers; it also comprises representatives of the British Electrical and Allied Manufacturers' Association and the British Engineers' Association. Substantially it may be said to contain representatives of all bodies interested in the testing of heat engines. There are also honorary members acting in an advisory capacity.

The work of the committee has been divided, as regards the preparation of the codes for the various types of heat engines, between two sub-committees each of three panels, while there are also four other sub-committees dealing with special matters common to all heat engines. The work is carried out by verbal discussion and by writing.

The following is a list of the codes required and, with three exceptions, they have been passed to the editing committee for co-ordination:—Boiler and its accessories, steam reciprocating engine, steam turbine, condensing plant, gas engine, gas producer, petrol and paraffin engine, heavy oil engine. By combining these codes any actual plant can be dealt with.

The codes for comprehensive trials consist of a series of items tabulated on forms in such a way as to make it easy to enter the data and the results in a simple manner. The form when filled up becomes the report of the trial.

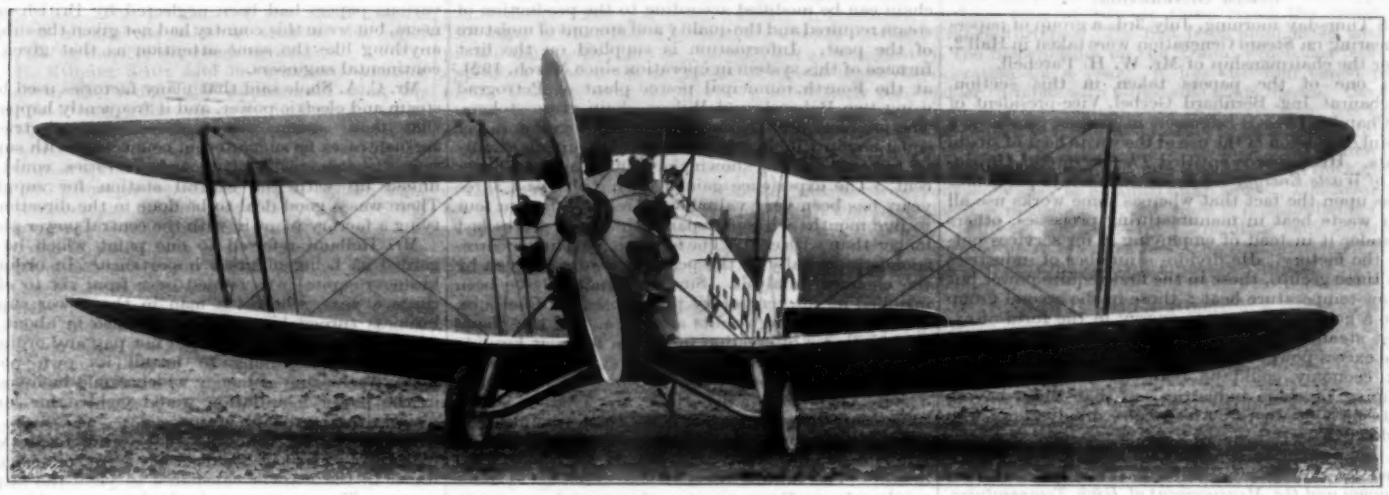
The codes for commercial trials are much reduced in length, as they include only such items of the comprehensive code as are needed—apart from description of plant—to obtain the fuel consumption per brake horse-power or other contractual guarantee.

Copies of the codes in typescript have been, and are being, sent to various users and manufacturers asking them to fill them up with the results of some test they have made, as it is thought that any defects in the codes or any ambiguity in the wording will thus come to light. It may even be necessary to carry out special tests for the purpose of ascertaining definitely the suitability of the codes, or alternatively the committee may be able to obtain permission to be present at some trials carried out in the course of business.

To ensure that the report and the codes prepared by the committee shall be generally acceptable, the

THE "BRISTOL BLOODHOUND" BIPLANE

THE BRISTOL AEROPLANE COMPANY, LIMITED, BRISTOL, ENGINEERS.



view has been taken that matters of doubt or those in which a consensus of opinion is desirable, should be discussed at joint meetings before a final decision is taken. For instance, a discussion was held on April 8th, 1923, on the Standards of Comparison for Internal Combustion Engines based on a note prepared by Professor Wells. Much useful information was obtained which is now being assimilated, and later on other meetings will be held to report the result arrived at. The present meeting had the same object in view. It is proposed to have a final discussion of the report at this Institution, and after any matters resulting from that discussion have been dealt with, the report and the codes will be presented for approval.

The committee is in correspondence with a similar committee established by the American Society of Mechanical Engineers, and has already obtained much benefit from such interchange of thought and hopes that further benefit will accrue.

The author proposed the following subjects for discussion :—

(1) In the 1913 code the lower calorific value was adopted; after discussion the present committee propose to adopt the gross—or higher—calorific value.

(2) It is proposed to omit from the Boiler Code the expression "lb. of steam evaporated from and at 212 °F."

(3) The committee does not propose to include the term "boiler horse-power."

(4) Are water meters and steam meters admissible in comprehensive trials for scientific purposes ?

The "Bristol Bloodhound" Biplane.

THE "Bristol Bloodhound" two-seater biplane, illustrated herewith, has been produced by the Bristol Aeroplane Company, Limited, for reconnoisance or fighting work. The structure is entirely of metal except for the covering of the wings, tail element and fuselage, which is of the usual fabric. The engine fitted is the air-cooled radial "Bristol" Jupiter of 400 horse-power. Tank capacity sufficient for 104 gallons of petrol and 15 gallons of oil is provided. The petrol feed is obtained by means of centrifugal pumps, a hand actuating petrol pump and gravity tank being incorporated in the system. The pilot and gunner are accommodated in adjacent cockpits, and the view is exceptionally good, as the wings are disposed with a large stagger and large "sweep-back." All the control surfaces are balanced, and the machine is, we understand as a consequence, exceptionally light and powerful on her controls. The undercarriage has a very wide track, and is of the combined oleo and steel spring type. Complete dual control is fitted. The armament includes two Vickers' machine guns, fitted with "C.C." firing gear, operated by the pilot, and one Lewis gun on a standard Scarff ring mounting, operated by the gunner. Stowage space is provided for 1600 rounds of ammunition for the Vickers' guns and seven double ammunition drums for the Lewis gun. Fittings are also installed for the carriage of bombs, electrical generator and accumulators, the necessary identification, landing and navigation lights, Verey's pistol and ammunition, oxygen apparatus and fire extinguishers, and lighting is also provided in connection with the complete set of navigation instruments which is installed.

GRAIN ELEVATORS IN SOUTH AFRICA.

ABOUT a dozen out of the thirty-six grain elevators which are being erected in different parts of the Union of South Africa, mainly to deal with the maize crops, have now been completed. The capacities of thirty-three of them, which are being erected in the various grain centres, average about 3230 tons, though one elevator, that at Moorreesburg—a wheat centre—has a capacity of only 2600 tons. The largest elevator is being erected at Durban dock. It will have a capacity of 42,000 tons. Another export grain elevator is being erected at Cape Town and is practically completed. This elevator is to-day the tallest building in South Africa. It is 180ft. high and has a capacity for 30,000 tons. The Durban elevator will be the same height when completed.

It is claimed that a world's record was broken in the building of the Capetown elevator. No less than 4800 cubic yards of concreting was accomplished in 14½ days. The builders ascribe this record as being largely due to the quality of the South African cement (Cape Portland), which was found to be extremely suitable for the purpose. The number of bags of cement used totalled 17,500, while 145 tons of reinforcing steel were used in the construction of the bins. Roughly, the amount of concreting totalled 20,000 cubic yards. When the building operations were in full swing, 400 Europeans and 600 non-Europeans were employed. At some stages the work had to be carried on day and night. Apart from the foundations, the building itself has taken just a year to build.

The elevator has an intake capacity of 1000 tons per hour, and a similar loading capacity. When it is fully at work, it is not expected that it will take more than a couple of dozen men to operate it. The cost, according to the late Minister of Railways and Harbours, Mr. J. W. Jagger, will be about £400,000. Owing to the drought and the ravages of the locusts, the maize available for export this season is not likely to exceed 2,000,000 bags, as against nearly 6,000,000 in 1923. As this quantity will be distributed between the four Union ports—Capetown, Port Elizabeth, East London and Durban—the quantity to be dealt with at the Capetown elevator will be very small this year.

THERE has been a great strain thrown upon every member of the staff of the Metropolitan Railway as a result of the British Empire Exhibition. This extra work has been borne not only by the station staff and the trainmen, but by the repairers and overhaulers of rolling stock, track, signals, &c. The company, in appreciation of this, is paying every servant a bonus of 10 per cent., and the general manager's intimation as to this says: "The directors hope that the staff will accept with the bonus an expression of their high appreciation of their devotion to duty displayed by all grades in the stress of the exceptional traffic and of their confidence in the continued loyalty of the staff to the company's interests."

The World Power Conference.

No. II.*

STEAM GENERATION.

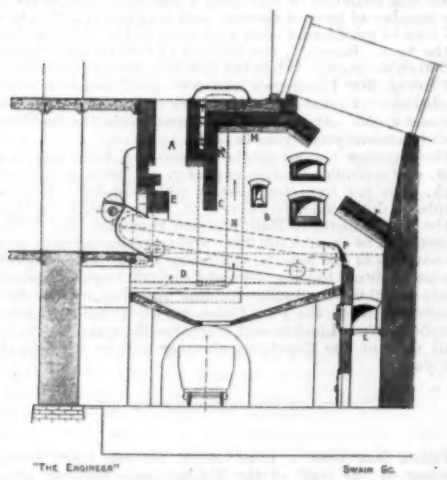
ON Thursday morning, July 3rd, a group of papers all bearing on Steam Generation were taken in Hall 2, under the chairmanship of Mr. W. H. Patchell.

In one of the papers taken in this section, Oberbaurat Ing. Bernhard Gerbel, Vice-president of the Chamber of Civil Engineers in Vienna, presented a careful discussion of the use of the waste heat of steam plants. His paper is entitled *The Reciprocal Utilisation of Waste Energy.* In it the author lays particular stress upon the fact that whereas some works use all their waste heat in manufacturing processes, others squander it instead of employing it for services outside the factory. He divides a number of industries into three groups, those in the first require power but no low-temperature heat; those in the second group have a good deal of waste energy in the form of exhaust steam to dispose of; and those in the third have excess power to get rid of. The author suggests that economy could be realised by an intelligent grouping of these industries, so that those having waste heat or waste power might supply those who needed it.

A long paper of considerable interest was contributed by Sir Robert Hadfield. It is entitled *Fuel Economy and the Measurement of High Temperatures.* The author advances the proposition that the knowledge of the temperature distribution in fuel consuming plants is one of the most important factors in the study of fuel economy, discusses the comparative deficiency of knowledge of the effects of high temperatures, and indicates the importance of research in this direction. He then surveys at considerable length certain fields in which pyrometry has enabled accurate heat balances to be obtained; the most notable of these fields are steam boilers, forge and heat-treatment furnaces for steel, and open-hearth furnaces. Discussing the future of very high temperatures in boilers, he mentions the fact that steel capable of standing high temperatures is now available as the result of the researches of a group of eminent French metallurgists, amongst whom he mentions especially M. Chevenard. This steel, which is known as A.T.V., and is being made in this country by Sir Robert Hadfield's firm, is practically non-scaling up to 1050 deg. Cent., resists the sulphurous products of combustion, and has remarkably high tenacity at temperatures as high as 900 deg. Cent., when the strength of other steels is negligible.

In a paper, entitled *Coke as Fuel for Steam Raising,* which was presented by Mr. E. W. L. Nicol, engineer and fuel expert to the London Coke Committee, the author says: "Attention should therefore be directed to devising processes by means of which bituminous coals of all descriptions may profitably be utilised with a view to produce—(1) Fuel oils for internal combustion engines and for steam raising; (2) motor spirit for road and aerial transport; (3) gaseous and solid fuels for industrial and domestic use. The successful and adequate development of such processes would go far not only to render the country more independent of foreign supplies of liquid fuels, but would tend to mitigate the coal smoke evil, and also contribute to the more economical working of the coal industry itself." He shows by reference to actual plants that coke is now being successfully used on a large scale for steam raising.

A paper by a Russian delegate, Professor T. Makariew, describes a new kind of *Furnace for the Combustion of Peat.* From the section reproduced



PEAT FURNACE

herewith, it will be seen that the furnace is divided into two parts—part A is the self-feeding furnace itself; part B, the combustion chamber with chain grate N. Small arches C separate the two parts, and underneath them is the opening through which the peat passes into the combustion chamber. The drying of the peat is effected in part A by air passing through arches E; combustion occurs in part B, where all the successive phases of the process take place. Scrapers P are provided to remove the clinker. Forced draught is generally used. The speed of the chain can be modified according to the production of steam required and the quality and amount of moisture of the peat. Information is supplied on the first furnace of this system in operation since March, 1921, at the Fourth municipal power plant at Petrograd using two Babcock and Wilcox chain grate stokers. The production of steam reached 50 kilogrammes per square metre of heating surface. Complete results of tests are given, showing an efficiency of 76 per cent. The experience gained during the past three years has been very valuable. Arches last from four to five months without repairs, the chain grates last longer than with coal. The formation of clinker corresponds practically to the percentage of ash given by the chemical analysis. Similar furnaces have been installed at the temporary power plant of Chatoura. Practical operating results are given. All the plants now in course of erection in Russia for peat burning are being equipped with this new system of furnace.

A paper, entitled *German Practice in Exhaust Steam Engineering,* by Herr H. Treitel, covers somewhat the same ground as that occupied by Herr Bernhard Gerbel's paper mentioned above, but it handles the subject in more technical detail. The author reviews the different systems employed in Germany for the useful consumption of exhaust steam and for avoiding losses due to condensation, he discusses the development of high pressures and notes their influence upon the generation of electricity and of manufacturing methods in his country.

Another German delegate, Herr K. Rummel, presented a contribution, entitled *Blast-furnace Gas Economy in Ironworks.* He considers the blast-furnace as a gas producer and establishes what he calls the "qualitative coefficient" or "quality factor." The monetary value of 1000 cals. of blast-furnace gas is in Germany about 20 per cent. higher than the monetary value of the original coal. The "quality factor" shows this relationship. It is obvious that in certain circumstances it becomes desirable to augment this factor. For example, in a blast-furnace coal is not used, but coke, and the 20 per cent. referred to above disappears when the factor is the relationship between blast-furnace gas and coke, and not between the gas and the original coal. If coal could be used in place of coke in the blast-furnace the factor 1.2 would exist. With this factor as a basis, the author discusses the economy of various heat plants; he shows under what conditions the gas engine is superior or inferior to the steam turbine; makes the same comparison for blowing engines; discusses the application of the factor in connection with blast-furnaces in iron and steel works; and touches upon the employment of exhaust gases from gas engines for steam raising.

Another paper taken on Thursday morning was written by Mr. W. M. Selvey. It deals with *Pulverised Fuel for Boilers,* and covers a good deal of ground which has been made familiar during the past few years. Mr. Selvey recognises that there are difficulties in effecting the adoption of pulverised fuel in this country. He remarks that "the amount of unsaleable fuel is not large in any locality, as most British coals are good. Such does exist, however, and this points to experiments at the pithead, which some collieries are already commencing. Given good success with 'run of mine' or 'through and through' coal at the pit head or even 'all below cobbles,' a check would be given to the movement from the 'centre of gravity of the load' to the 'water facilities centre' now taking place, in favour of a movement to the 'centre of gravity of fuel production.' The principal requirement, 'elbow room,' is equally available, and it is being found now that the margin between good cooling tower stations and riverside stations is diminishing, owing to the concurrent increase in the economic size of turbines and improvement in the art of steam condensation. It is to be hoped, therefore, that one of the new stations to be built, say, in Yorkshire, Derbyshire or South Wales, may be based on this consideration. It is submitted that it is imperative that the matter be tried out as early as possible."

Mr. Leonard Harvey, in a paper entitled *The National Economic Power of Solid Fuel in Relation to its Scientific Utilisation,* covers some of the same ground that Mr. Selvey traverses. He urges the employment of pulverised fuel and of a fuel from which the hydro-carbons have been distilled, and he also looks to the day when super-power stations will be erected in the neighbourhood of the pithead. He develops his argument with many striking figures and examples. We note, by the way, that Mr. Harvey believes that the time is not far distant when in every industrial country the public services—coal, transportation, and power and lighting supplies—will be mainly controlled by the nation, and he holds that "in the fulfilment of any broad programme of distillation, pulverisation, concentration of power generation and fuel efficiency in any country wherein such can be applied, the works required will be of such magnitude that the resuscitation of engineering industries and the great relief of unemployment on work of national value will be brought about in the most speedy manner possible."

Referring to a group of seven papers presented at this meeting, Mr. Patchell said the subject raised in them was that of waste heat economy, and there was not a single contribution by an English author. Not one of the items mentioned in the various papers had been neglected by British engineers, but we in this country had not given the subject anything like the same attention as that given by continental engineers.

Mr. C. A. Shole said that many factories used both steam and electric power, and it frequently happened that more steam was required than electricity. In such cases he suggested in connection with super-power development that such factories could be linked up with the central station for supplies. There was a good deal to be done in the direction of tying a factory plant in with the central power plant.

Mr. Holland referred to one point which he regarded as being of great importance. In ordinary business capital was turned over from six to eight times a year, whereas a man in the power supply business turned his capital over once in about six years. It followed that it did not pay any ordinary industrial undertaking to install its own power plant, as the sum of money which would be invested in the power installation would yield a far larger return in the ordinary business.

Dr. A. F. Enström said that owing to the very high price of fuel in Sweden they were compelled to use it in the manner calculated to yield the largest return. The use of steam for both power and heating was very important, and it was a combination which was going to be employed to a much greater extent all over the world. A phase of the situation which must command attention was that the demand for power and heat did not coincide.

Dr. Klingenberg referred to the advantages of thermal storage. He believed the system would be generally adopted for installations where a fair amount of power was required for heating purposes.

Mr. E. W. L. Nicol thought it had not been made quite clear that while within certain limitations high temperature gas coke was a highly efficient fuel for steam generation, it was not efficient unless the moisture content was within 6 or 7 per cent. Coke containing from 10 to 15 per cent. of moisture was, however, quite common. Referring to Mr. Rodhe's paper, he pointed out that high CO_2 in the flue gases was not necessarily a test of efficient combustion, and indeed might indicate a serious loss. It was quite possible for a boiler plant with 12 per cent. of CO_2 to work at a much lower efficiency than one with 5 per cent. Mr. Rodhe showed that there was a critical point in combustion, and that point was when there was the maximum CO_2 consistent with the absence of CO and unburnt gases. The average CO_2 content in British practice was from 7 to 8 per cent., and represented a very serious loss due to the presence of excess air. We were losing 40,000,000 tons of coal a year from lack of appreciation of the scientific principles of fuel using.

Mr. David Brownlie put in a plea for the adoption of an international code for the testing of boiler plants. Methods of using fuel were exceedingly wasteful, and the average efficiency obtained was not more than 60 per cent., which on land boilers alone represented a loss of over 100,000,000 tons of coal a year. There were three methods of testing boilers in use, that of the American Society of Mechanical Engineers, the continental code of the German Society of Engineers, and the British code of the Institution of Civil Engineers. He had made a study of the last named, and it was a disgrace to British engineers.* We were now within sight of the 500,000 kilowatt station, and the time was opportune for a re-examination of the whole subject of the utilisation of exhaust steam for heating and perhaps power. The iron and steel industries presented a particularly bad example of the waste of heat in every direction.

Mr. W. L. R. Emmet expressed his interest in high temperature work. He had used mercury for power purposes and had been running a boiler at a temperature of over 500 deg. Cent. Service of that character put great strain on the metal, and he had been very anxious to find a material which would resist oxidation under such conditions and could be worked into tubes. He would like to have more information concerning the metal referred to by Sir Robert Hadfield.

Mr. Sandford Riley, speaking on behalf of stoker manufacturers, welcomed the proposal of an improved material being made available. One of the important problems of stoker operation, apart from efficiency of working, was the cost of maintenance. Sir Robert Hadfield's paper was a useful contribution which opened up the possibility of decreasing the maintenance costs of mechanical stokers.

Mr. J. J. Lassen, referring to a paper by Mr. Olof Rodhe, entitled *Complete and Incomplete Combustion with Reference to Combustion Economy,* said it was essential to give more study to the combustion of gases, and in indicating the existence of a critical point Mr. Rodhe had done useful service. The papers which had been read dealt very largely with the case of the super-power station and large instal-

* No. I. appeared July 4th, 1924.

* We trust Mr. Brownlie is aware that the revision of this code has been before a committee for some time. It was discussed publicly on Thursday, July 3rd. See a leading article in this issue.

lations generally. He thought that more consideration might be given to the achievement of greater economy of operation in smaller power stations. In Great Britain there were about 47,000 boiler installations, and of them only about 20,000 were of large size. The problem of the small station was by no means the same as that of the super station, but it must receive consideration.

Mr. E. Kilburn Scott said he wondered whether everyone in the room fully appreciated what Sir Robert had said. His research had come at a psychological moment because synthetic ammonia plants worked at very high pressure and very high temperatures. The Claude process required a pressure of 900 atmospheres, 14,000 lb. per square inch, and a temperature of about 500 deg. Cent. Some of these plants would probably be built in Great Britain, and it would be a great convenience to get catalyst bombs locally.

Mr. Charles Merz, speaking on a paper by Messrs. P. Junkersfeld and George Orrok on *Steam Power Production*, said that the North Tees Station, which was the first to adopt high pressures and temperatures was founded on Dr. Ferranti's idea of using progressive feed heating and reheating. It was satisfactory to know that, at any rate, the steam elements in such an installation, which were expected to give trouble, had now been proved satisfactory in practice. On the subject of pulverised coal, he asked whether it was a settled idea in the minds of those who were using it on a large scale that the furnace brickwork should be given up.

Another speaker said it was significant of the trend of development that the first large station in the United States to use only pulverised fuel had held the record for fuel economy for the last two years, and that a second big station which was using pulverised fuel was setting up an equally good record.

It was also pointed out that with the furnaces at Hellgate it had been found possible to improve the efficiency of the boilers up to about 19 lb. of water evaporated per square foot of surface. On a 28-hour test at lower rating the efficiency of boiler, superheater and economiser had been 92 per cent., and on a very high power test 78 per cent. With new plants it was found possible to increase the evaporative capacity to from 23 lb. to 24 lb. per square foot of surface, but the record in the case of some small type boilers was 28 lb.

Water Power Production.

On Thursday afternoon two dozen papers dealing with the general aspects of Water Power Production were taken under the chairmanship of Mr. Arthur Surveyer, president of the Engineering Institute of Canada. Many of these papers dealt with the progress and practice of special countries, whilst others covered subjects of more extended interest. In the space at our disposal we can do no more than outline the contents of a few of the papers.

In a short paper Mr. Eduard Suess (Austria) described a type of water turbine he has invented for utilising the energy of river currents, a source of power which has hitherto been developed hardly at all. He employs a propeller-type turbine which is placed near the front, and narrower, end of a conical casing. He shows that with a current of 3 metres per second 20 horse-power can be developed with a propeller surface of 1.7 square metres, or, say, a diameter of 1.5 metres.

In an interesting communication entitled *Factors of Efficiency in Hydro-electric Development*, Lieut.-Colonel C. M. Norrie alludes to the fact that whereas the efficiency of hydro-electric machinery has received great attention, other aspects of efficiency have not received sufficient consideration. He considers these aspects under three heads, of which the first is National Efficiency. In this section he mentions the framing of legislation "tending to decrease the capital of obtaining concessions, land and wayleaves, and of compensating riparian rights." The removal of anomalous taxing and rating which weigh very heavily on water power is called for. In the next section he discusses Commercial Efficiency, and in a concluding section Technical Efficiency.

Signor G. Motta (Italy) provided a paper in which he shows that it is unwise to "harbour too many illusions as to the possibility of integrating the hydraulic deficiencies of one watershed with the surplus of another, located at a certain distance from the former." He holds that to insure constancy of supply in such conditions reliance must be placed on steam power stations working in conjunction with hydro-electric stations. In a paper contributed by Colonel Charles Keller (America), entitled *Power Developments in Navigable Rivers*, several of the big river power plants of America, amongst which Muscle Shoals, Alabama, may be specially mentioned, are described in some detail. The author observes that it is necessary to recognise "the inability of such plants to function economically as independent units, and of the consequent advisability of incorporating them as parts of large electric systems, whose power resources are sufficiently varied, and whose output and load are of such magnitude as to cause the variability of the run-of-river plant to become a thing of little or no importance."

The question of the *Regulation of Hydro-electric Energy* is fully discussed in a paper by Messieurs Arbelot and Dupin (France). These authors note that "in the recent rapid development of hydro-electrics the question of regulation has only progressed in so far as the tendency has been towards combinations more and more complex in character. The other is that the developments already accomplished and those that may be regarded as imminent appear to depend much less on technical improvements than on a more precise and rational conception of the problem from its economic and commercial aspect. This evolution has not yet finished. Important problems, such as the harnessing of tides, the accumulation and storage of power which may be available for use when it is wanted, are far from being solved. The field is still wide for all who have an interest in the subject, and for all who wish to help and contribute to its progress and success."

Steam Generation.

Another group of papers under the general heading Steam Generation was taken at the afternoon session. Three of them were by American authors. Mr. Jacobus presented a contribution, entitled *Recent Practice in Steam Generation in the United States*, Mr. W. S. Monroe one on *The Use of Steam at High Pressures and High Temperatures in Central Stations*, and Mr. W. L. Emmett one on *Power from Mercury Vapour*. The question of high pressure was also handled by several other members. Dr. Friedrich Münziger, of Germany, gave a paper on *The Influence of High-pressure Steam on the Design and Economy of Large Steam Boiler Plant*, and Herr H. O. Hartmann one on *High-pressure Steam: Its Present and Future Application in Power and Heating Plants*. Mr. Wiberg, of Pinspong, took as his subject *High-pressure Water-tube Boilers*; whilst Mr. Blomquist, of Stockholm, presented a paper entitled *Steam Generation at Extra High Pressures*.

The first paper taken was prepared by Sir James Kemnal, and is entitled *Steam Generation*. In it, Sir James says "the future lies in the utilisation of very high pressure and superheat in the steam turbine. The modern steam turbine being a high-speed engine, occupies a comparatively small space, and is relatively cheap to construct for the power generated. Its thermal rival—the Diesel engine—is limited to low speeds of revolution, on account of limiting reciprocating stresses; also, the cost of electrical generators working in conjunction with Diesel engines is relatively high for the power developed. The reason that I anticipate generating steam at pressures of from 500 lb. to 1500 lb. superheated to 750 deg. Fah., or higher, is that experience with the lower pressure of 500 lb. is already sufficient to warrant incurring the extra capital cost involved in higher pressures, in view of the increased thermal efficiency to be expected. I have Sir Charles Parsons' authority for stating that the increases in thermal efficiency over that at 250 lb. due to increased working pressure, would be estimated to be as follows:—500 lb. per square inch working pressure, 6 per cent.; 1000 lb. per square inch working pressure, 11 per cent.; 1500 lb. per square inch working pressure, 15 per cent. To put the matter in another way, assuming a boiler efficiency of 84 per cent., the thermal efficiency, coal to electricity, of the complete unit of turbine and boiler at 1500 lb. per square inch working pressure would be in the neighbourhood of 30.8 per cent., which approaches very closely to the thermal efficiency realisable in large Diesel engines. The boiler installation would include re-heater, water economiser and air heater, and it is assumed that the following would be the operating conditions:—Final temperature throughout, 750 deg. Fah. total; exhaust vacuum at the turbine, 29.25in. (barometer 30.00in.); re-heating to 70 deg. Fah.; feed-water heating to within 50 deg. Fah. of boiler temperature; and under the assumption that the flue gas final temperature would be prevented from increasing appreciably by the use of air pre-heating."

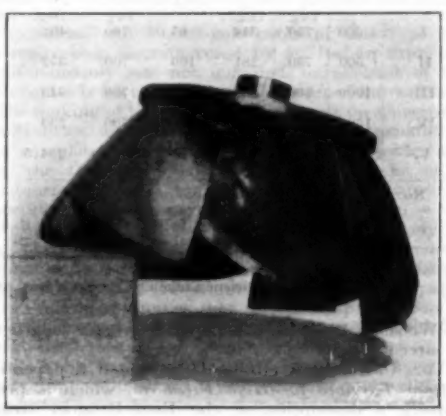
In his paper Mr. Blomquist shows the advantages that follow from the employment of very high pressures, and enunciates the two following rules for extra high-pressure boilers:—(1) Steam generated must be removed immediately from contact with the heating surface; (2) all tubes exposed to the heat of the furnace must be allowed to expand freely. These conditions, he says, are satisfied by the Atmos boiler, the principal feature of which is that steam is generated in rapidly revolving tubes, so arranged that they may expand freely without strain.

Mr. Wiberg's paper is devoted to the description of what may be called a Swedish modification of the Babcock boiler. The principal feature of this boiler is the employment of straight instead of sinuous headers: but, in order to accommodate as many tubes as the normal form, the headers are so staggered that, in any group of three, the middle one is further forward than the other two. Thus, the outside *headers* may practically lie in contact with the centre *tube*. Considerable economy of space may be effected in this way.

Water Power Production.

On Friday morning Mr. S. Kloumann (Norway) took the chair in Hall 1, when a further group of papers on Water Power Production was discussed. These papers all dealt with the civil and mechanical engineering aspects of water power development. In one, provided by the Federation of Austro-German Engineers, particular stress is laid upon the application of the propeller turbine in Austria. This type of turbine runs at two or three times the speed of Francis turbines. The first large plant fitted with it is the Siebenbrunn on the Traun, which has been in operation for a year. It has two four-vaned propeller turbines with adjustable guide blades. Cavitation, which presented some trouble at first, has been overcome. A notable feature of the Siebenbrunn turbines is that both the stationary and the moving blades are adjusted simultaneously, so that the highest efficiency may be attained at all times. This arrangement is rather costly, and since it is improbable that it will ever be necessary to regulate each separate turbine up to one-fifth load, the combination of full-admission turbines with adjustable turbines is foreshadowed.

Mr. Hjalmar O. Dahl (Sweden), in a paper entitled *Modern Tendencies in Water-wheel Design*, also deals with high-speed turbines, and mentions the Kaplan turbine, which runs at a specific speed of 800, is of the propeller type, and has adjustable blades. The number of blades may be as low as four or even two. Another turbine of an interesting form is the Lawaczeck, of which one having a diameter of 6 m., "the largest turbine runner hitherto made in the world," is being erected at Lilla Edet. Its specific speed will be about 600, and its revolutions per minute 62.5. In this turbine the water flows in a centripetal direction, there is no shrouding, and each blade is constructed separately and is bolted to the hub. The model illustrated herewith gives an idea of the form.



LAWACZECK TURBINE RUNNER

Mr. Birchard Taylor (America) supplied a paper on *The Hydraulic Reaction Turbine*, which is full of valuable particulars about American practice. Referring to the fact that much greater heads can now be utilised in reaction turbines, he mentions the Oak Grove station, which uses a normal head of 857ft. The single turbine develops 35,000 horse-power. In the other direction, the harnessing of low heads is being effected by the propeller type of turbine, which is characterised by its very high specific speed.* The Great Falls plant of the Manitoba Power Company has a turbine of this type, working at a head of 56ft. with a specific speed of 154, and develops 28,000 horse-power. The runner is practically a six-bladed propeller. In an interesting section of his paper, Mr. Taylor discusses draught tubes and points to the success of those of an annular type, the general form of which may be described as a solid parabolic cone placed upright within a similar but hollow cone, the annular space between the two forming the draught tube. We have already referred to the Lawaczeck type of propeller turbine, and it is only necessary to say that Dr. Ing. Franz Lawaczeck (Germany) presented a paper, entitled *Large Low Head Water Power Developments*, in which the origin and employment of this type of turbine is described.

Steam Utilisation.

On Friday morning four papers were taken for discussion in Hall 2.

Mr. John W. Lieb (America), who occupied the chair, said that the desire of the central station engineer to improve the efficiency of operation had led him in many instances to scrap, after very limited service, the finest types of triple and quadruple-expansion engine, and then replace them with the latest type of turbine plant. There had within his personal experience been some striking illustrations of the part which obsolescence played in the economies of power operation. New problems had now arisen for the attention of turbine designers; questions of higher pressures and higher temperatures and higher speeds were bringing into view new and more severe conditions which had to be met. Important, however, as was efficiency and

* The specific—or characteristic—speed of a turbine is the speed of a one horse-power turbine under a head of 1ft.

economy of operation, reliability in service was a fundamental requirement of power station plant, and was the crucial test of success in commercial operation. The confidence of the consumer in continuity and reliability of service must not be shaken. The tendency of the time was, of course, for larger and larger aggregations of plant. In the United States most of the new stations were being designed to contain plant of from 300,000 to 500,000 kilowatts, and units as large as 100,000 kilowatts were in the hands of designers at the present time.

The four papers were then presented in abstract for the purpose of a joint discussion.

The first of them is one on *Steam Turbines* by Sir Charles Parsons. In it the author traces the rise and development of the steam turbine ashore and afloat, and estimates that the total horse-power now generated by steam turbines in the whole world is nearly 120 million. He indicates the four following directions in which further improvement may be sought without the employment of higher temperatures:—(1) Feed heating by steam drawn from the turbine; (2) increase of the boiler pressure; (3) re-heating the steam after partial expansion; (4) improvement of the vacuum and of the means of employing it. The following table is given:—

Table showing the Overall Thermal Efficiencies which it is estimated could be Realised with Increased Boiler Pressures, up to 2000 lb per square inch.

(Based on the Callendar Tables and Formulæ for the Properties of Steam.)

Col. No.	1	2	3	4	5	6	7	8	9	0	11	12
Case No.	S.V.P. lb. gauge.	S.V.T. °F.	°F. initial superheat.	Assumed reheat pressure lb. abs.	Reheat temp. °F.	Restored superheat °F.	Exhaust vacuum ins. Hg. Bar. 30.0"	Stage feed water heating from 65° F. up to (°F.).	Thermal efficiency (from steam to electricity)	Assumed boiler plant efficiency (including all aux.).	Overall thermal efficiency (from coal to electricity).	Per cent. gain.
		Deg.	Deg.		Deg.	Deg.	Inches.	Deg.				
I.	250	750	344	65	700	402	29.25	360	31.6	84.0	26.52	—
II.	500	750	281	100	700	372	29.25	420	33.5	83.5	27.97	5.45
III.	1000	750	204	150	700	343	29.25	510	35.2	83.0	29.20	10.08
IV.	1500	750	153	250	700	299	29.25	550	36.6	82.5	30.20	13.82
V.	2000	750	114	400	700	254.5	29.25	600	37.5	82.0	30.75	15.90

NOTES.—1. S.V.P. = Stop valve pressure.
2. S.V.T. = Stop valve temperature.
3. Feed water heated to within about 50° F. of boiler temperature by means of steam withdrawn from turbine blading at several points.
4. Boilers equipped with economisers or air pre-heaters or both, so as to recover heat from the flue gases and maintain high thermal efficiency.
5. Dynamo efficiency taken as 96.5 per cent. at full rated output.

We shall deal with this paper at greater length in a later issue.

Mr. C. F. Stork (Holland) presented a paper on *Steam Turbines for High Pressures*, which is principally a description of the Erste-Brünner steam turbine. The object of the designer of this turbine was to improve the efficiency at the high-pressure end, because it was held that in all existing types efficiency does not begin until the steam had been expanded in an impulse wheel to a low pressure; they are, in fact, low-pressure turbines. A 2300-kilowatt turbine of this type has shown an overall efficiency of 82.4 per cent. One of its essential features is that the high-pressure steam is admitted on the whole periphery and at low velocity. Furthermore, by insuring a high steam pressure after the first stage, the economy is retained even at reduced loads. Finally, the stresses in this type of turbine are lower than in other types.

A Swedish representative, Mr. Nordstrom, gave a paper on *Extra High-pressure Steam Turbines*, in which he dealt with some points in the design of the turbine constructed by the de Laval's Angturbins Company, of Stockholm. In this design a very high speed wheel is combined by gearing with a low-speed turbine. Mr. Nordstrom is not so positive as Mr. Stork about the necessity of admission all round the wheel. He says that as a rule the question for or against partial admission depends upon how great the variation in steam consumption is expected to be.

In the discussion Dr. Ferranti gave an account of some work he had carried out in past years on steam turbine design. In 1903 he reached the conclusion that the true line of progress was to build a re-superheat turbine and get as nearly as possible to isothermal expansion. Theoretically, that implied exhausting at nearly as high temperature as that with which the cycle started. It was decided to work with a moderate pressure, 200 lb., and reheat the steam at as many points as possible. That involved under all loads, but more particularly at light loads, a considerable transfer of heat from the steam at the low pressure end by means of a regenerator placed before the condenser. In about 1910 a two-stage turbine was built of 3000 kilowatts capacity running at 3000 revolutions. It had no dummies and the blading was on the Parsons principle. There was an outer casing of wrought steel, and inside it another drum of the same material. The turbine was run on trial many times and supplied power to the Vickers' works at Sheffield, and the general performance was satisfactory. Steam was superheated without undue difficulty up to 750 deg. Fah. After exhausting, it was re-superheated and returned to the turbine. The turbine gave wonderful results as far as economy was concerned, and he had hoped to go on with the work. He dropped out of it when enough had been done to put on the market a turbine which, from the point of view of economy, was a great advance on anything which had then been achieved. Four years ago he came back to the same idea, and built a small engine in which the regenerator, which was within the cylinder, and the piston was at red heat and worked well. Several small turbines, which were of 10in. diameter, were run at 26,000 revolutions per minute, and at a bright red heat.

Mr. Pokobradsky, dealing with means of providing for increased pressures and temperatures, referred to the work which had been done by the B.E.A.M.A. and the Institution of Mechanical Engineers in throwing light on a new law governing steam flow. What had been done indicated that the efficiency was high at velocities in the neighbourhood of 300ft. per second, and that a second maximum appeared at a velocity of 1500ft. per second. Those results suggested a new line of turbine design in which use would be made only of very low and very high velocities; a high-pressure part with small stages and a low-pressure part with high stages. Such a turbine would involve the use of very high pressures inside the casing and raised the problem of how the joints of the casing were to be made tight. The trouble could be overcome by using an internal casing fixed to the external casing in a flexible manner. Between the two casings the steam pressure would be held at a medium figure, so that the effect of the high pressure would be taken by the two casings, so that each had only a moderate pressure to sustain. The same thing applied to the temperature.

Mr. Chittenden (English Electric Company) referred to the question of disc vibration, which was raised in the paper by Mr. Hodgkinson, and how it had been avoided. There was now no difficulty in that direction, and in Great Britain he had knowledge of only two instances of trouble with disc vibration in impulse turbines. Mr. Hodgkinson suggested that the correct thing was to have an impulse stage at the high-pressure end of the turbine. He agreed that in many cases that was good practice, but it was controlled to a great extent by the relative output and speed.

Mr. M. Tonig, referring to Sir Charles Parsons' paper, said the author had put in an admirably clear manner the three main directions in which the original steam cycle was being improved. With regard to the conditions of heat rejection, it was not possible to do more without the adoption of a binary system than minimise those losses by improving the design of the exhaust and condenser. Doubts had arisen, however, whether the ingenious attempt to establish the binary system could be justified. With reference to re-heating and maximum steam temperatures, the results of the Nozzle Research Committee's work showed a decrease in efficiency at high temperatures. Mr. Stork referred in his paper to what he called the "quality figure," and asserted that all existing turbines were defective in that respect as far as the high-pressure part was concerned. As Sir Charles Parsons pointed out, however, the criterion of efficiency was the velocity ratio. The tests on the disturbances set up by small obstructions in the steam path were very interesting, and emphasised the importance of nozzle design.

Mr. O. Junggren (General Electric Company) said that the most recent type of turbine had single wheels throughout, and the characteristic of a conical construction of rotor giving a full admission and uninterrupted path for the steam, producing a simple and efficient turbine and providing the electrical industry with a unit of large capacity of exceedingly simple construction. The development of the turbine had now reached a point where no great advancement in efficiency could be expected. The most promising field was to be found in an increase of temperature and pressure in conjunction with bleeding for heating the feed water, and reheating the steam after it had done a certain percentage of the total work. That practice increased the efficiency of the steam cycle, and, in addition, should considerably reduce blade deterioration. The losses in the last blade of the turbine had received considerable attention, and numerous devices, including double flow and multiple flow, had been proposed with the object of reducing that loss. It often happened that the use of such devices was associated with other losses, so that there was no improvement in the net result. A preferable method was to give attention to substantial blade fastening and non-vibrating blades. During a recent period there had been a considerable increase in the blade speed of all turbines, and the idea that safety lay in those speeds was being disproved. Safety lay rather in the prevention of temperature and vibratory stresses. There appeared to be two ways in which further economy in the production of power might be brought about. First, by using the Emmet mercury process in combination with the steam cycle at moderate pressure; secondly, by an increase in the pressure and temperature of the steam. In the near future, large turbine units might be operating at pressures of 1500 lb. and in sizes of 100,000 kilowatts.

Mr. Orrok said it was an extraordinary feature of the turbine business that with the most astonishing variations in design there was most remarkable uniformity in performance guarantees. What the central station engineer wanted was a turbine which would run for 8760 hours, could be started up at two minutes' notice any time from cold, and in which the blades and other parts did not deteriorate.

Mr. S. G. Watson said it was a question of how much had to be paid for various improvements like multiple casings. It would be of interest if Sir Charles Parsons or one of the other writers of papers would give an indication of the relative cost of two 20,000 kilowatt machines, each with its own casing, and one 40,000-kilowatt set. It had to be borne in mind that the best machine of to-day was not going to occupy that position in three or five years' time, and it was necessary to obtain during a comparatively short period of service a saving which bore some relation to the additional capital cost. He would like to pay a tribute to the way in which alternator design, particularly in the case of British machines, had kept pace with the development of the turbine. Whatever the turbine maker required in the way of speeds had been given to him by the manufacturer of alternators.

Mr. Bernard Price, representing large undertakings on the Rand, raised the question of maintenance costs to which designers had not always perhaps paid sufficient importance. It would, he feared, be found that as designs developed on the lines indicated in the papers the cost of maintenance would become more serious.

Mr. Stanley Cook, replying to some of the points raised on Sir Charles Parsons' paper, expressed doubts whether the external casing was necessary, as even with the highest pressures which had been mentioned, there should be no difficulty in producing a satisfactory design without it. On the subject of the work of the Nozzles Research Committee, to which reference had been made by Mr. Tonig, it was difficult to see what was the connection between decrease of efficiency with increased velocity and reheating, because the velocity of the blades and the steam was entirely a matter of desiga, and could be adjusted at will. It would appear from the observations of some of those interested as users of turbine machinery that they were filled with a laudable desire of obtaining machines of higher efficiency without having to pay for the improvement in design. It would not be difficult to show, however, that manufacturers had gone far to meet even that extreme demand.

WATER POWER PRODUCTION.

In Hall 1 on Friday afternoon Dr. Ed. Tissot, President of the Swiss Association of Electricians, took the chair. Four papers were taken. Two of them were contributions by Mr. Cornelio Arellano, in which a method of preventing rubbish carried down by a river from reaching turbines is described; the other two, by Mr. Arvid Ruths and Mr. A. Frey Samsioe, describe the measures taken in Norway and Sweden respectively to deal with *Ice Troubles in Water Power Plants.*

POWER FROM OTHER SOURCES.

An interesting group of five papers was considered in Hall 3 on Friday afternoon, under the chairmanship of Mr. T. C. Thomsen (Denmark). Three of these papers deal with wind power. The first, by Professor Schou (Denmark), is entitled *Calculations Regarding Wind Power Based on Meteorological Data.* The author observes that whilst we might expect that the power developed by a wind motor would vary as the third power of the velocity of the wind, yet elaborate tests carried out during recent years have demonstrated that "the energy produced by a windmill can for all practical purposes be considered as a linear function of the velocity of the wind when the question is of winds of the usual intensity."

The second paper, by Mr. P. Vindin g (Denmark), is entitled *Modern Wind Motors.* In it the author discusses at some length the mathematics of windmills, and gives some particulars and illustrations of a form designed by him in which the sails are of aerofoil shape and preferably six in number. Several mills of this kind have been erected in Denmark.

The third paper, entitled *Modern Plants for Wind Electric Power Stations,* is also by a Danish author,

Mr. R. John Jensen, who describes various electrical devices in connection with the generation of electricity from windmills.

In another paper, Prince Piero Ginori Conti describes the *Larderello Natural Steam Power Plant.* Recent borings have given considerable quantities of steam at a pressure of two atmospheres or three-quarters of an atmosphere higher than the old borings. With these new bores, turbines can be driven direct without condensers. A small experimental turbine is already working well under these conditions.

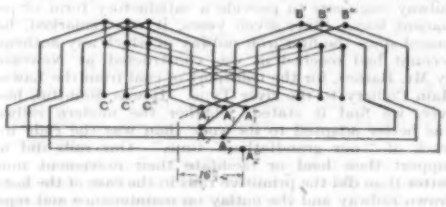
The last paper of the group was contributed by Sir Charles Bedford, and is entitled *Alcohol as a Source of Power.* In it the author reviews the whole position with regard to fuel alcohol. He touches upon the production of alcohol in the Tropics, and expresses his conviction that the industry can only prosper under private and not under Government control. The best method as far as tropical production is concerned would appear to be to encourage native proprietors to distil it on a small scale in co-operation with European works.

Prince Conti, in reply to questions, said the wells ranged from 60 m. to 200 m. in depth. A new system of boring had been evolved to overcome the difficulties and risks attached to boring in the presence of highly heated steam. The bore-hole was 60 cm. in diameter. In addition to hydrogen the steam contained sulphur and helium and gave indications of radio-activity. It was pointed out in the course of the discussion that at Lake Talbot, New Zealand, a steam vent giving steam at 180 lb. pressure has been yielding constant supplies for a generation. No use had been made of this steam.

POWER TRANSMISSION AND DISTRIBUTION.

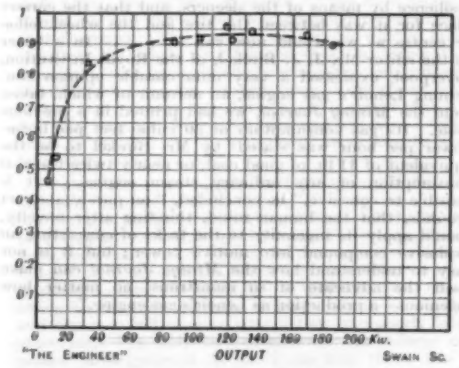
On Monday morning, July 7th, a large group of papers under the heading given above was taken. We give outlines of a few of the papers.

The *Frequency Converter* described in a paper by Professor Dr. Paul Müller is a new type of machine for converting three-phase 50-cycle current into single-phase current with a frequency of 16⅔ cycles, and



STATOR WINDING

facilitates the supply of single-phase current to rail ways from normal lighting and power networks. The frequency converter is the combination of a synchronous three-phase motor of 50 cycles and a synchronous single-phase alternator of 16⅔ cycles in one single machine, with an iron frame, stator and rotor windings common to both. Outwardly, the machine resembles an ordinary synchronous machine. It has a stator with standard three-phase winding and a rotor with a field winding, which is supplied



EFFICIENCY CURVE

with direct current over the slip rings. A commutator is not required. The machine has two fields, a two-pole and a six-pole field, both of which are superimposed, and result in a combined saddle-shaped field. To avoid mutual influences of the two frequencies, the stator winding must be so designed that the frequency 50 only obtains at the points of connection for the three-phase end, and the frequency 16⅔ only at the points of connection of the single-phase end. The winding for 16⅔ cycles is influenced by the two-pole field; and not by the six-pole field. Its fundamental form is produced by two groups of two bars in series at intervals of two-thirds of the pole-pitch of the two-pole field, *i.e.*, with "shortened winding pitch." The two-pole field affects the winding in the usual manner, whilst the six-pole field produces two equally high pressures opposed to each other. The winding for 50 cycles must be influenced by the six-pole field, but not by the two-pole field. Its fundamental form is produced by groups of three bars in series at intervals of the pole pitch of the six-pole field. A diagram—above—shows the common stator winding. An efficiency curve based or an actual test of one of these machines is also shown, and it will be seen that the efficiency is considerably higher than that of an ordinary frequency changer.

Professor Miles Walker, in a paper entitled *The Improvement of Power Factor*, considers various methods of improving the power factor of transmission lines and induction motors. In dealing with transmission lines, the author refers to the advantages of direct current. It would seem to be possible, he says, to convert to extra high voltage direct current by means of vacuum tubes, and a suitable arrangement of transformers, but to re-convert from direct current to alternating current, some form of rotating synchronous converter would probably be the most effective piece of apparatus. It is quite possible, the author contends, that the combination of some kind of synchronous converter and vacuum valves may be used for the re-conversion from direct current to alternating.

Some years ago experiments were made at the Manchester College of Technology on the commutation of current supplied by coils of high self-induction, and the method is shown in the accompanying

COMMUTATION EXPERIMENT

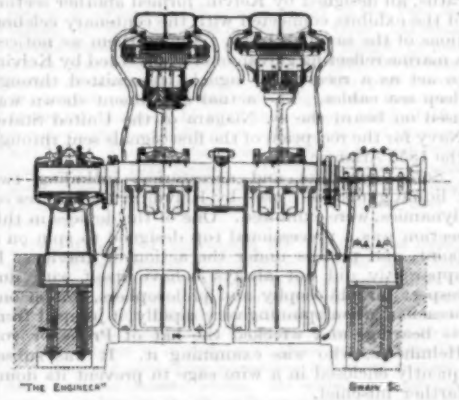
diagram. The six coils of a 440-volt alternator were brought out to a six-part commutator, as shown, and direct current was fed into the commutator by means of two compound brushes P and N. Each brush consisted of two parts, as shown at P and P′, N and N′. The part P′ and N′ which were leading had mercury arc-rectifiers V in series with them, so that the current could pass in the direction indicated by the arrow head, but could not pass in the opposite direction. When the machine was used as a motor, the brushes were rocked back so as to obtain a very strong commutating field. This field would have produced over-commutation, and bad sparking, if it were not for the action of the valve. With the valve the machine ran absolutely sparklessly, because the commutating field, though it could push the current down to zero in the leading part of the brush, could not carry it through zero on account of the non-return action of the valve. Thus each commutating bar left the brush when there was no current flowing from it. A small battery was placed at B and B′ to neutralise the effect of the back voltage of the valves and make them share the current with the trailing part of the brush. This principle can be extended so as to obtain perfect commutation on a commutator connected to a high-voltage permutator.

Suppose that the crest value of the pressure between the bars is as high as 1000 volts, the value during the commutating period need not be higher than 300 volts, so that it is an easy matter to stop a reverse current by means of a valve. The resistance of modern high-vacuum valves is rather higher than that required for use, but it is possible by special design to reduce the resistance. The battery B B′ can be replaced by a series wound generator, the field of which is connected in series with the direct-current main. The series generator can be made to act as a negative resistance, and if the speed is properly adjusted, it can compensate for any resistance in the valve circuit. In the event of it being desirable to rotate the brushes instead of rotating the commutator, the current from brushes P and P′ would be taken to separate slip rings, so that the valve and series-wound generator would not have to revolve with the brush. Another alternative is to employ three brushes, say, P, P′ and P″. The intermediate brush P′ would have an ordinary low resistance mercury arc in circuit with it to prevent reverse current. The brush P″, which would be the last to leave the commutator bar, would have a vacuum valve in circuit capable of withstanding a much higher voltage than the mercury arc valve. The purpose of the intermediate brush P′ would be to provide a low resistance path for the current, while the brush P is moving across the gap between commutator segments. If the sparking could be entirely eliminated, one could deal with very high voltages on a single commutator. It may even be possible to build a commutator entirely immersed in oil.

In a paper by Ing. Luigi Emanueli, entitled *Electric Cables for Extra High Tensions*, it is shown that under the conditions in which energy is transmitted to-day the best pressure for transmission up to 20,000 kilowatts over a group of three single conductor cables is about 20,000 volts, and that if it is desired to increase the pressure the value of the dielectric power factor should be lowered. The manufacture of high-pressure cables, the author states, has now reached a point at which one can reasonably contemplate three-phase transmission at 130,000 volts over three single-conductor cables and in Italy studies are being made with a view to arranging actual experiments. The possibility of manufacturing cables destined to work at such high pressures depends on careful reduction to a minimum of the gas which is occluded between successive layers of the insulating material. When, in the future, experiments on cables at 130,000 volts are made, a special type of cable will be used with an impregnation of liquid oil. The conductor will be tubular in form, thus allowing the fitting of expansion boxes at the ends of the cable, so that the thermal expansions and contractions of the oil shall not act detrimentally to the impregnation of the cable. An 80,000-volt cable of this type has already been manufactured by an Italian firm, but unfortunately was not installed, on account of the customer being unable to fulfil his part of the contract. The making of the joints and terminals presents great difficulties, which are due largely to the impossibility of completely expelling the gas. In the joints and at the terminals, the displacements of the equi-potential surfaces from the insulating layers are certainly much greater than in the cable itself.

Another paper about which a few words may be said is one contributed by Mr. W. Borgquist (Sweden), entitled *Economic and Technical Organisation of Large-scale Power Distribution in Sweden.* In this paper the author estimates that the total production of electric energy in Sweden amounts to about 2,800,000 kilowatt-hours a year. Something like 95 per cent. of this energy is generated in water power stations, the rest being supplied mainly from steam power stations operated in combination with industrial heating installations or from reserve and supplementary stations, the latter co-operating with hydro-electric plants according to the usual scheme, *i.e.*, thermal energy being used to supplement the water power during low-water seasons and also to take care of the peak loads during the seasons of maximum demand.

One factor of paramount importance for the power



25 AND 50-CYCLE DOUBLE GENERATOR

scheme is the electrification of the railways, and one of the most far-reaching Government actions of later years, undoubtedly, is the decision to electrify the State Railways from the general power supply system. The first big railway electrification in Sweden, the ore railway Lulea-Riksgränsen, is supplied with single-phase current from special generators and high-tension feeders for single-phase current; this is no doubt the correct solution in a part of the country where no very important general power distribution exists. The Stockholm-Gothenburg line, however, which is now being electrified, is to be supplied from a number of synchronous three-phase single-phase converting stations, connected to the existing power system in Central Sweden. By this arrangement a highly undesirable duplication of generating and transmitting equipment has been obviated and unity of power supply has been ensured, a matter of great economical importance, in particular for a country like Sweden, where large amounts of energy must be transmitted over great distances. Incidentally, the

many synchronous motor-driven railway converting stations spread over the whole system at uniform distances will be of great value for voltage regulation within the far-flung high-tension distribution system in the country.

One great practical difficulty in linking up the State systems in Central Sweden was the difference in frequency; the Trollhättan station operated at 25 cycles, while the Alvkarleby and Motala plants were equipped for 50 cycles. This obstacle was surmounted by installing at Trollhättan two double generating sets—see the illustration on the preceding page—each having one 25-cycle and one 50-cycle generator for 12,000 kilovolt-ampères on the same shaft, connected to a turbine for 9000 kilowatts. The power delivered by the turbine can thus be transmitted either to the 25 or the 50-cycle busbars and at the same time an additional 3000 kilowatts per set can be converted from 25 to 50 cycles or *vice versâ*, one generator per set operating as a synchronous motor and aiding the turbine, the other working as a generator at a slight overload and with almost unity power factor.

Conversazione of the Institution of Civil Engineers.

THE annual conversazione of the Institution of Civil Engineers was held at the house of the Institution, Great George-street, Westminster on Wednesday evening. It was very largely attended, and many visitors who are in England at this time for the Exhibition and World Power Conference were present. An excellent collection of exhibits, many of great historical interest, were arranged in the library.

Among these exhibits chief prominence was fittingly given to an extensive range of apparatus, models and instruments devised by Lord Kelvin. The first to attract our attention was a model of the rotating coil apparatus for the determination of the ohm. The rotating coil method was proposed to the British Association Committee by Lord Kelvin, and was carried out by that Committee. It was repeated in later years by Lord Rayleigh at Cambridge.

An early model of the Thomson tide predicting machine next engaged our notice. The tide predicting machine is used for analysing the curves drawn by a self-registering tidal gauge, so as to exhibit the constants of the harmonic curves. From a knowledge of the constants the tidal heights can be predicted, either by means of the tide predicting machine itself or by calculation. The chief feature of the machine exhibited was the disc-globe-cylinder integrator invented by Lord Kelvin's brother, the late Professor James Thomson. The machine shown could analyse four harmonic constituents. A much larger machine, to analyse a tidal curve containing eleven constituents in all, was made for the British Association Committee on Tidal Observations. Farther on, we came across an early tidal gauge invented by Lord Kelvin, and installed on the Clyde in 1882. It is upon the curves drawn by this type of machine that the tide predictor works.

A collection of electrostatic voltmeters, quadrant electrometers and other electrical measuring apparatus, all designed by Kelvin, formed another section of the exhibits connected with the centenary celebrations of the savant's birth. Among them we noticed a marine reflecting galvanometer, invented by Kelvin, to act as a receiver of signals transmitted through deep sea cables. The actual instrument shown was used on board the ss. Niagara of the United States Navy for the reception of the first signals sent through the 1858 Atlantic cable.

Some gyrostats and accessories, including two "liquid gyrostats," used by Kelvin in his lectures on dynamics, were exhibited. One of the devices in this section was a precessional top designed to spin on a point, and precess under the action of gravity. It apparently did not always behave itself with due respect for philosophy and philosophers, for on one occasion, when spinning very rapidly, it jumped from its bearings and wrecked the hat of Professor von Helmholtz, who was examining it. It was subsequently enclosed in a wire cage to prevent its doing farther mischief.

From some models illustrating Kelvin's theories of the constitution of matter—models which struck us as being much simpler than those apparently called for by current theories on the same subject—we passed to an interesting chart dealing with the laying of the Anglo-American cables of 1865 and 1866. The chart was constructed by Mr. Donald M'Farlane, Kelvin's assistant, who was on board the Great Eastern during the expeditions. It showed the course taken by the first cable from Valentia until it parted more than half-way across on August 2nd, 1865. On September 2nd, 1866, it was successfully spliced some distance back, and continued on to Heart's Content, Newfoundland. Meanwhile, in 1866, a second cable had been laid without mishap from Valentia to the same point on the other side during the period July 13th to July 26th.

Most of the exhibits we have referred to were being shown by the Natural Philosophy Department of Glasgow University, the department over which Kelvin presided so long and so brilliantly. The Eastern Telegraph Company also showed some Kelvin relics, among which we noticed an automatic curb transmitter, which was used for a short time on the Aden–Bombay cable. This transmitter was the joint patent of Kelvin and Professor Fleeming Jenkin. Kelvin's mirror speaking galvanometer, first used on the 1858 Atlantic cable, and his marine ironclad galvanometer, specially designed for use on board cable-laying and repairing ships, but subsequently superseded by the moving coil pattern, were also shown by the company. In the same section we saw another joint invention of Kelvin and Fleeming Jenkin's, namely, a slide for potential and other tests of submarine cables, an invention which was superseded by the double dial pattern of instrument.

Among the other apparatus and devices exhibited several were familiar to us as having been shown at the recent Royal Society Conversazione. Professor E. N. da C. Andrade and Mr. J. W. Lewis showed their apparatus for exhibiting vortex motion of viscous liquids between two rotating cylinders. Inside a glass tube of 0.9 cm. bore a nickel-plated cylindrical steel rod was mounted to run truly concentrically. In the annular space, 0.16 cm. wide, there was a colloidal solution of silver, the metallic particles in which, when illuminated and viewed through a microscope, revealed the flow lines of the liquid when the rod was rotated. The section seen through the microscope was a vertical one and embraced a short length of the annular space on one side of the rod. At slow speeds the motion of the suspended particles was seen to be concentric with the rod, but at and above a certain critical speed a circulation in an axial plane was set up. This circulation was clearly observed to consist of a series of vortices, the alternate vortices rotating in opposite directions. We understand that Mr. G. I. Taylor has investigated the motion mathematically and has obtained agreement with the observed facts. The experiments have little direct bearing on the theory of lubrication, for in that subject of investigation we have to deal with a bearing which is excentric to the journal.

Professor Gerald Stoney and Mr. J. P. Chittenden exhibited the various forms of apparatus which they have devised for studying the vibration of steam turbine discs and shafts. We dealt with the shaft vibration apparatus in our issue of May 16th, in connection with the Royal Society Conversazione. The disc vibration experiments were made with an actual steel disc clamped horizontally and set into vibration by means of electro-magnetic force applied at one point of the periphery. The nature of the vibration was revealed by means of sand scattered on the surface of the disc. In the case of a 72in. disc, it was found that the vibrations took place about three, four and five nodal diameters, when about 4000, 7000 and 11,000 vibrations per minute respectively were applied to the disc. Another interesting method of studying the same phenomenon consisted of attaching a thin flexible rubber disc to the shaft of a variable speed electric motor, with horizontal shaft. It was shown that if the natural period of the disc corresponded with the period of the motor, a standing wave was generated in the disc, giving it a most contorted but steady form. In rubber, of course, the displacement of the disc particles produced by the wave was exaggerated, but even the limited displacement possible in the case of a turbine disc would, we were informed, be very dangerous. Some turbine mishaps in America are believed to have been caused by standing wave vibration.

An interesting form of mould prepared under the "Meloche" process and used for casting "Ford" carburetters and pistons was shown by Mr. John L. Hodgson. The "Meloche" mould, it is stated, is suitable for any iron between malleable iron containing 0.75 per cent. silicon and 2.5 per cent. carbon, and grey iron containing 3 per cent. silicon and 3.75 per cent. carbon. It is also suitable for brass and aluminium. The shrinkage of the casting is stated to be but half that of a sand moulded casting. The mould is of cast iron. Its surface is protected by a coating of refractory material, about $^1/_{64}$in. thick, and by a thin coating of lampblack. The refractory material—bauxite, fire-clay or kaolin—is mixed with a solution of water glass, and is applied with a brush when the mould is at a temperature of about 350 deg. Fah. The lampblack is cleaned off and renewed each time a casting is made. The metal cast in the mould is said to be soft and close grained, as a consequence of its slow rate of cooling, to have no hard or oxidised skin as a consequence of the carbon face of the mould, and to be free from blow-holes as a consequence of the fact that no gases are produced in the mould. One mould, it is stated, can produce in the course of its useful life 10,000 to 20,000 castings, while on a twelve-mould casting machine operated by one pourer, one core setter and one labourer, 400 castings can be made in an hour.

A roller type extensometer, exhibited by Professor E. H. Lamb, appealed to us very greatly, by reason of its simplicity, sensitiveness of measurement and robustness of principle. A pair of parallel planes was clamped opposite each other on the sides of a vertical test specimen, the gauge length being defined by knife edges on the planes. In each pair, one plane moved with the lower knife edge and the other with the upper. Between each pair of planes towards the top was inserted a roller held simply by friction, and carrying a mirror at one end. The stretch of the specimen resulted in each of the rollers rotating with their mirrors, the one moving oppositely to the other. The degree of stretch was measured by observing through a telescope a scale as reflected by the two mirrors in turn. Except for a first calibration of the roller diameters and a measurement of the distance of the scale from the mirrors, no preliminary determinations are necessary. The extensometer can be allowed to remain on the specimen without hurt right through the breaking point.

Mr. Edward Box exhibited a model of his flap form of dock gate, a form which, he tells us, is now in use at three docks on the Mersey, two on the Clyde and two on the Tyne. The gate is of steel work, is in one section and hinges about its horizontal lower edge. When lowered, it lies slightly below the level of the sill of the dock and rests on buffers. It is in part balanced by means of water-tight chambers worked into its construction, and requires about the same power for its operation as that supplied for an ordinary form of dock gate. The lowering of the gate creates an outflow of water from beneath it, which flow tends, it is claimed, to prevent silting at the entrance. Mr. Box also showed an interesting model of a self-docking floating dock. In an ordinary self-docking dock, the sections must not be longer than the width that can be admitted between the side walls, with the result that the structure as a whole is weakened by the occurrence of sectional planes at or near the middle line of the dock, where the bending moment is greatest. In Mr. Box's dock the structure is in three principal sections, the central section being built in one piece and comprising more than half the entire dock length. Each of the two end sections consists of a floor in four pieces and two side walls, each in one piece. Each side wall is united to two alternate floor pieces. The end sections can thus be extended in width by drawing them apart. When one is so extended, it can dock the other in the unextended state. When both are extended, they can dock the central section.

SIXTY YEARS AGO.

AN article in our issue of July 8th, 1864, gives us today an interesting picture of the efforts of the early railway engineers to provide a satisfactory form of permanent way. Sixty-seven years, it was remarked, had passed since the first iron railway of which any authentic account had reached us was constructed at Newcastle by Mr. Barnes, for the transport of coal from the Lawson Main Colliery to the river Tyne. It was doubtful, however, we find it stated, whether the modern railway was better adapted to its work than was the rude iron track of "our grandfathers' time." Our rails did not support their load or facilitate their movement much better than did the primitive rails in the case of the horse-drawn railway and the outlay on maintenance and repair was nearly as high. Not even the most ardent admirer of existing arrangements, it was written, would urge that the permanent way of 1864 was as perfect as it should be. The outstanding difficulty in a problem that was simple in the abstract was the necessity for the provision of resiliency in the roads. The introduction of that quality was immediately accompanied by a lack of permanence in the rails, chairs, sleepers and ballast which in turn entailed heavy maintenance costs, and increased resistance and consumption of fuel. "Permanence and resilience," it was remarked, "have never yet gone together in our railway track, and it is much to be feared that they never will." After referring to the great mechanical mistakes made by George Stephenson and Brunel, the first in laying the rails of the Manchester and Liverpool Railway on stone blocks and the second in spiking them to a continuous longitudinal sleeper borne on piles driven into the ground, the article proceeded to discuss some problems connected with sleepers and ballast. Incidentally it was stated that up to 1857 17 per cent. of the whole cost of French railways had been expended on ballast. The conclusion reached was that it was wrong in principle to provide the requisite resilience by means of the sleepers, and that the correct place for it was between the tire and the wheel felloe or centre as we would now call it. . . . In a letter to the editor Mr. J. J. Birckel, of the Royal Institution, Liverpool, expressed a very unfavourable opinion concerning Lenoir's gas engine, an account of which, taken from the *Mining Journal*, we had printed in a previous issue. Its gas consumption of 50 cubic feet per horse-power per hour was stated by Mr. Birckel to be the equivalent of 11 lb. of good coal, or nearly twice the coal consumption of any ordinary steam engine. "It is possible to conceive," he concluded, "on purely abstract grounds, that the human mind, thirsting after novelty, should apply its ingenuity to the tasks of converting an explosive compound into motive power; but it is not easy to understand how the *Mining Journal* can make itself the advocate of so monstrous—no matter how ingenious—a production as Lenoir's gas engine."

DEFINITE steps towards the adoption of a Dominion wide standard for electrical installation equipment werd taken at a meeting of the committee of the Canadian Engineering Standards' Association for this purpose which was held recently at the quarters of the Engineering Institute of Canada, Montreal. The committee arranged for the immediate employment of a small staff of experts to commence the preparation of a draft code of rules and specifications for electrical appliances, which will be based on the already existing regulations in the various Provinces and States. This draft will then be submitted to the committee for criticism, amendment and approval. It will then have to be submitted to the authorities of each Province for their approval, so that ultimately a Dominion-wide standard of rules and regulations for electrical equipment may be established. It is expected that this work will occupy a year or more.

Railway Matters.

THE retirement, as on the 30th ult., is announced of Mr. Charles Jones, the chief electrical engineer of the Metropolitan Railway. Mr. Jones has been succeeded by Mr. P. R. Boulton.

THE new general manager of the Italian State Railways is Signor Comm. Ing. Cesare Oddone, the manager of the Genoa district, and at one time chief of traction on the Mediterranean Railway.

WE regret to hear of the death of Mr. W. Parker, the manager of our excellent monthly contemporary, the *Railway Magazine*. Mr. Parker was until quite lately the President of the Railway Club.

AFTER the recent strike on the tube railways, Mornington-crescent Station was not re-opened with the other stations. It was thought by the Underground people that it might permanently be closed. It has now been re-opened.

THE Spanish Directory has decided on the construction of a railway between Santander and Calatayud, *viâ* Burgos and Soria. The cost is estimated at 350 million pesetas. The new line will place Santander and Valencia in more direct communication than at present.

ACCORDING to some figures furnished by Mr. Gosling, in answer to a parliamentary question, it appears that of 681,247 out of the 681,778 servants employed by British railways in March, 1923, 13,209 were rated at over £311 per annum, or, say, 120s. per week, and 421,262 were rated at £160 per annum, or 60s. per week and under.

THE death is announced of Mr. W. H. Stanier, well known among railwaymen and among those who sell railway material as, until 1915, the stores superintendent to the Great Western Railway, and who then became an assistant to the general manager. After he retired at the end of 1916 he resumed railway work in order to assist the Railway Executive Committee.

IN our leading article of the 4th inst. on the Railway Centenary, we spoke of the size and wealth of the railway men's unions. The report of the National Union of Railwaymen has since been issued, and it shows that when in 1913 the Amalgamated Society and two minor unions combined in the N.U.R., their funds stood at £400,000. A year ago they amounted to £1,500,000, and to-day they stand at £1,700,000.

THE traffic receipts of the four grouped companies during the last three months of the half year just ended were very satisfactory, but they do not compensate for the losses, caused by the railway strike and the dock strike, in the first three months. The total decrease for the six months was £2,223,000 on the London, Midland and Scottish, £2,107,000 on the London and North-Eastern, £791,000 on the Great Western and £184,000 on the Southern.

THE Great Indian Peninsula completed a very successful half year on March 31st. Whilst its receipts, when compared with the corresponding period of 1922–23, showed a decrease of 1.36 per cent., the expenditure had a decrease of 11.73 per cent., and the net earnings were 29.54 per cent. more. The reduction in expenditure was mainly the result of a very exhaustive inquiry into the working of all departments. The chairman of the company, speaking at the half-yearly meeting the other day, was very confident as to the success of the Bombay electrification scheme, which is now well in hand.

WITH the view of reaching some definite policy respecting the railway situation in northern Canada, a conference between Dominion Cabinet Ministers and representatives of all provinces interested will be held in Winnipeg during this month. The purpose of the gathering will be to face the real facts in connection with the railway situation. Maps will be studied, data collected, reports of engineers reviewed, and costs computed. It is expected that some acceptable and workable plan for the future railway service of Northern Alberta and British Columbia will be reached. The Hudson Bay Railway may also come up for discussion.

THE construction of the first electric locomotive for the Detroit, Toledo and Ironton Railroad will be started on July 15th. The railway is owned by the Ford Motor Car Company, and the engine was designed by engineers of that company. The locomotives, which will be built in the Detroit, Toledo and Ironton shops at River Rouge from parts that have already been constructed, is designed to utilise high-tension current from an overhead circuit, and to carry its own transformer. It is stated that it will be 117ft. long, will weigh 340 tons, and will have a tractive effort of 200,000 lb. It is intended especially to handle large shipments of coal.

DURING the three months ended September 30th last, eighteen fatal accidents to railway servants were inquired into by the Assistant Inspecting Officers of the Ministry of Transport. One-half of these cases were considered to have been due to want of care on the part of the deceased himself or of some of his fellow-servants. Four were due to misadventure, the cause of one was unknown, one was owing to the look-out man helping instead of watching, and one man fell over an obstruction improperly left by other men. In only two cases were the railway companies' arrangements at fault—in one there was insufficient clearance at an engine shed door, and in the other a capstan failed.

THE Strathaven and Darvel branch of the Caledonian section of the London, Midland and Scottish Railway runs from Strathaven to join the Galston and Darvel branch of the Glasgow and South-Western section. The traffic over it is very light, and during the war it was almost closed. At the request of farmers and others in the neighbourhood the former services were revived on the condition that as much traffic as possible should be put upon the line. That has not been done; most of the traffic continues to go by the high road that parallels the railway, and, in contrast with the experience before the war, the expenditure exceeds the receipts. It has been reported that the line is to be closed, but matters have hardly got as far as that. It is first to be seen what a meeting with the farmers will achieve.

Notes and Memoranda.

THE brown coal briquetting plant of the Victorian Electricity Commission, at Yallourn, which is about to start operations, is to have an ultimate capacity of some 3500 tons a day, but is starting with about one-tenth of that amount. The raw coal to be used has a net calorific value of 4800 B.Th.U. with 50 per cent. of moisture, and the briquettes will contain 12 per cent. of moisture, and have a calorific value of 9300 B.Th.U. per pound. Exhaust steam from the turbines driving the plant is used to dry the coal.

THE present installation of the Johannesburg power station consists of four 3000-kilowatt sets and one 6000-kilowatt set. In addition, there are 2000 kilowatts of old reciprocating plant and 2300 kilowatts of non-condensing plant, making a total on paper of 22,300 kilowatts. There are nineteen boilers and all are mechanical stoker fired. The peak load on the plant for the year ended June 30th, 1923, was 15,050 kilowatts. The water supply is obtained from bore-holes sunk on the power station site, and make-up water is obtained from the town supply.

NEW experiments to demonstrate the application of wireless telegraphy to railways are reported to be in progress, the aim being to prove the practicability of transmitting from running trains. Reception of broadcast matter has already been carried out in expresses with a fair amount of success, but the present experiments are being confined to the transmission and reception of wireless telegraphy. To test the possibilities of continuous communication from a train to a number of fixed stations the Radio Society is equipping a coach attached to a train running from London to Newcastle.

EXPERIMENTAL work by the American Department of the Interior metallurgists on reduction of iron oxide by carbon monoxide is progressing rapidly at the Northwest experiment station of the Bureau of Mines at Seattle, Wash. Reduction tests have been made at temperatures varying from 700 deg. to 1000 deg. Cent. at times from 1 hour to 5 hours on sizes up to 2in. Preliminary observations indicate that size has more influence than any other factor on rapidity of reduction. A piece 2in. in diameter was not completely reduced at 900 deg. Cent. in 5 hours. Magnetite reduces only about half as fast as dense hematite. A new and apparently accurate method has been developed for the determination of metallic, ferrous, and ferric iron in the same sample.

THE annual report of the Chief Inspector of Factories and Workshops states that last year 25 grindstones in Sheffield burst, nine of them causing injury to workmen. The increased use of "kind" or soft stones for the grinding of stainless cutlery and the use of newly-quarried stones in their green or saturated state are held to be the chief causes of the accidents. It is pointed out that the immature bonding of soft stones necessitates more careful consideration of speed, and that the tendency to overdo the tightening up of the plates holding these stones may lead to a further weakening of their resistance and cause disaster. The report adds that the grinding, glazing and polishing of cutlery by mechanical means is making headway, and it is likely that eventually natural stones will no longer be used.

A SERIES of tests in the making of synthetic cast iron in a commercial electric furnace has been completed at the experiment station of the United States Bureau of Mines. Both synthetic gray iron and mild steel were produced in alternating runs without trouble. Miscellaneous steel scrap of all kinds was charged into the furnace to produce various grades of iron. The results show that, under the conditions in this foundry, the synthetic product can compete with cupola iron and is superior in quality and strength. These experiments were made in a commercial direct-arc acid-lined furnace of 3000 lb. capacity. Under normal commercial conditions, excepting only those where some unusual trouble or delay was encountered, the average power consumption was 710 kilowatt-hours per ton.

A NOVEL method for the rapid and accurate estimation of the sulphur content of organic substances, described by Dr. H. Bahr, is mentioned in the *Chemical Trade Journal*. An intimate mixture of finely-powdered coal, "aluminium gravel (*aluminiumgriess*)" and barium peroxide, preferably in the proportions 0.5 gramme, 0.4 gramme and 3.0 grammes respectively, is made. This mixture is then briquetted, and the briquette is ignited by means of a bunsen after having been placed in a quartz crucible provided with a perforated cover. After cooling, the crucible together with its lid is treated with dilute hydrochloric acid, and the hydrogen sulphide evolved converted into cadmium sulphide in a 10 bulb tube; the latter being then estimated with iodine and thiosulphate in the usual way. The whole operation from the briquetting to the final titration can be carried out in 45 minutes.

A RARE accident, caused by the inhalation of the fumes from cadmium, which occurred to the engineer in charge of a paint factory, is mentioned in the annual report of H.M. Senior Medical Inspector of Factories. Usually the firm had received metallic cadmium in the form of sticks of the length of a pencil, but a few months previously had received the metal in the form of ingots, which had to be melted down to reduce their size. Instead of carrying out the operation, as should and could have been done, in the foundry, where there was a suitable hood and locally applied exhaust ventilation, the engineer, for reasons unknown, elected to do it in a gas-heated circular crucible in which was a vent hole unconnected with a flue to the outer air, and situated in an inadequately ventilated lean-to. The operation lasted three hours. Two men employed with the engineer became seriously ill, but recovered. The symptoms complained of were: Dryness of the throat, headache, rapid pulse, nausea, and passage of brown-coloured urine; feeling of cold was also complained of. These are the symptoms of brassfounder's ague, which are believed to be caused by burning of the metal zinc. Zinc and cadmium both belong to the same group of metals, and of the two, cadmium is regarded as the more toxic.

Miscellanea.

THE Electricity Supply Commission of South Africa proposes to put up a 30,000-kilowatt power-house on the Salt River foreshore for supplying Capetown.

ARRANGEMENTS are being made for the annual convention of the Western Canada Irrigation Association, which will be held in Calgary early in August, probably on August 1st.

THE exports of platinum from Colombia, *viâ* the ports of Buenaventura and Cartagena were, according to the latest returns, 4419 oz. troy in December, 1923, and 6250 oz. in January last.

IT is proposed to supply Edmonton, Canada, with water from Pigeon Lake, using Wizard Lake as a reservoir. The pipe line would be about 29 miles long from the reservoir, and a tunnel 9500ft. long would be needed between the two lakes. The suggested supply is 15 million gallons a day.

THE 410ft. steamship Egremont Castle, belonging to G. Chambers and Co., which was recently beached in the East River, New York, following a fire and explosion in her oil and spirit cargo, is being successfully salved. She has now been floated and brought alongside the wharf so that her lower holds may be discharged prior to making a complete survey of the ship.

THE Witbank power station of the Victoria Falls and Transvaal Power Company is to have an initial capacity of 60,000 kilowatts in 20,000-kilowatt sets, and it is expected that it will soon be extended to 100,000 kilowatts. Current will be transmitted to Brakpan, a distance of 76 miles, at a pressure of about 130,000 volts. The estimated cost of the scheme is £1,000,000, and the time taken to complete it two years.

THE construction of a dam across the river St. Lawrence is advocated by Colonel W. I. Gear, president of the Shipping Federation of Canada, as the best means of improving the navigation of the river. He suggests that the dam should be built somewhere between Champlain and Cap Rouge, and that it should hold up the water to a depth of from 37ft. to 40ft. Two large locks, 1000ft. long by 100ft. wide, and two smaller locks, would provide for the passage of vessels, while the fall of water would be utilised for power production.

IN replying to a deputation of the Australian Institution of Engineers, the Hon. W. N. Gillies stated that he had a very high regard for the engineering profession, and the deputation had impressed him with the importance of the engineers' work to the State and its development. He admitted that engineers generally did not receive adequate remuneration; in fact, some officers were much underpaid. He promised that the matter would be referred to the Cabinet with a view to its reference to the Public Service Commissioner and the Ministers concerned, for a general review of the conditions and pay of professional engineers in the Government service.

THE construction of the Vernon Hooper Dam, at Shongweni, which is to provide a new water supply for Durban, is being pushed on rapidly. The dam will impound the waters of the river Umlaas, and will cost about three-quarters of a million sterling. The section of the river selected for the dam flows through a valley rising steeply on both banks to a height of 300ft. or more. The dam will block this valley to a depth of 94ft. The dam will be 800ft. in length and 70ft. in section at the foundation level, tapering to about 10ft. at the top. There will be fifteen sluices for the passage of water, and a supply of 20 million gallons a day will be provided.

SHIPPING in and out of the Port of Vancouver for the calendar year 1923 showed an increase in all departments, according to the annual report of the Vancouver Board of Harbour Commissioners. Over 133,000,000 dollars worth of logs, lumber and grain freight, including wheat, was exported, an increase of 30,000,000 dollars in value of outgoing cargoes. Inward the port received 224,000,000 dollars worth of freight, an increase of 13,000,000 dollars. In 1923 there was a total of 19,608 vessels in and out of the port, with a total net tonnage of 8,427,683. This is an increase of 2959 ships and 792,289 tons over the 1922 figures. The total number of ocean-going vessels last year was 845, which had a net tonnage of 2,804,883 tons, an increase of 128 vessels over the previous year.

THE Minister of Agriculture, Mr. Buxton, was recently asked in the House of Commons whether any careful yearly record is kept of the effects of coast erosion, so that counteraction may be taken without delay if the occasion warrants it. Mr. Buxton stated that the only information which normally reches his department from time to time on this subject is in respect of those areas where there is a drainage authority possessing statutory powers to carry out sea defence works. He added that no direct action is taken by the State for countering coast erosion, and that the Royal Commission, which reported fully on the subject in 1911, suggested that the carrying out of sea defence works was not a matter for public expenditure, and, moreover, found that more land was being recovered from the sea than was being lost.

A PRELIMINARY survey has been carried out for the aerial ropeway which is to be constructed in Colombia for connecting Cúcuta and Gamarra, on the Magdalena River. The line will pass through the important towns of Santiago, Gramalote, San Pedro, La Cruz, Ocaña y Aguachica, and will have a total length of 96 miles. Its daily transporting capacity will be 400 tons in ten hours' work. Ordinary passenger carriages will be run along the line providing accommodation for four persons with their luggage, and special carriages will accommodate eight passengers. The ordinary cargo carriages will transport half a ton and the special trucks 1 ton. The speed of the wagonettes will be at the rate of 4½ miles per hour. Fifty horse-power oil engines will be used at the beginning. The total distance will be covered in twenty-three hours. The towers will be from 17ft. to 200ft. high, and there will be five in each kilometre. The diameter of the rope will be 1¼in. There will be thirty stations. The total cost of the work is estimated at 5,560,000 dollars.

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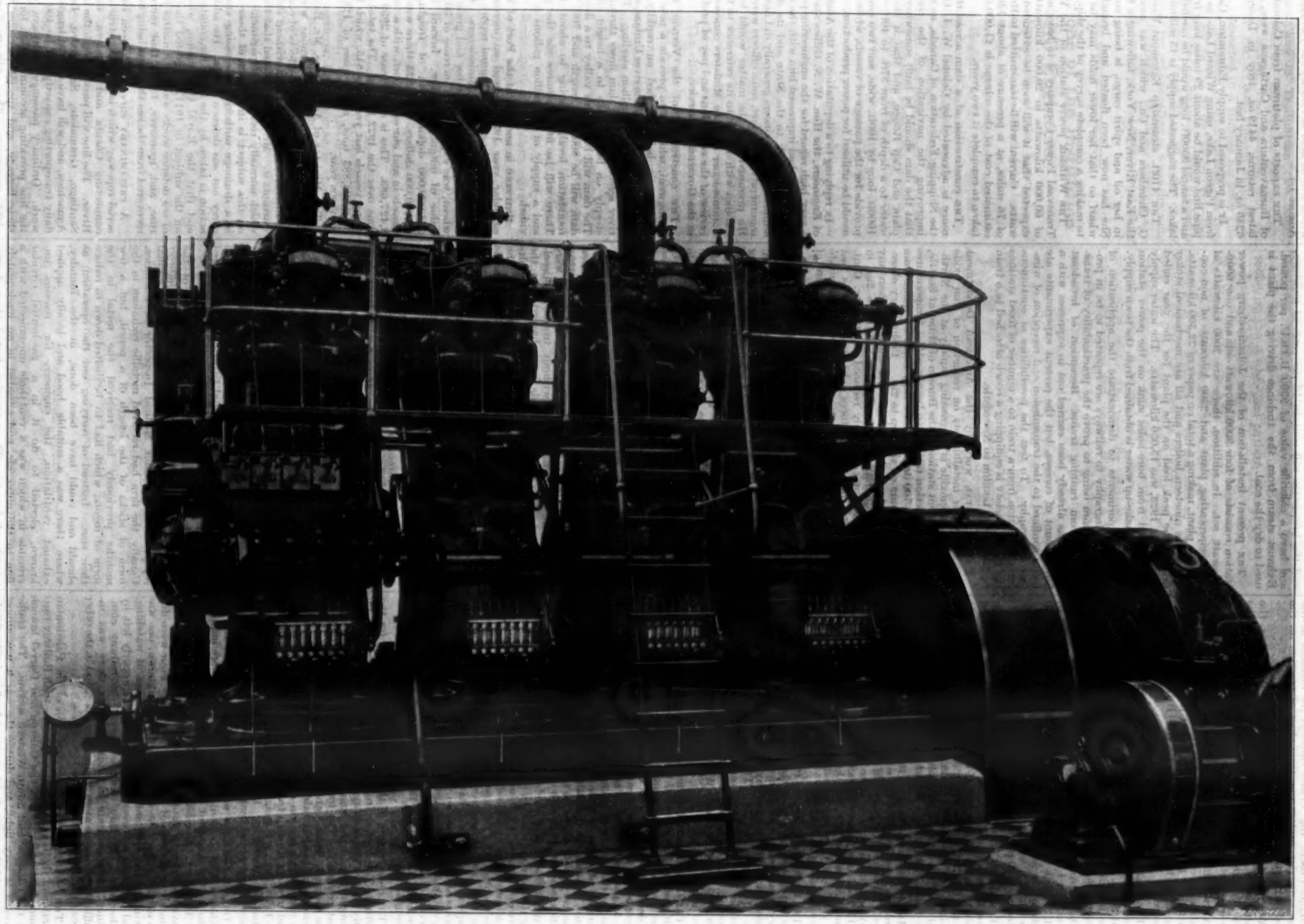

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Contents.

THE ENGINEER, July 11th, 1924.

	PAGE
A SEVEN-DAY JOURNAL	31
THE BRITISH EMPIRE EXHIBITION. No. XII. (Illus.)	32
A HUNDRED YEARS OF BRITISH RAILWAYS. No. II. (Illus.)	37
HEAT ENGINE AND BOILER TRIALS	38
THE BRISTOL BLOODHOUND BIPLANE. (Illus.)	39
GRAIN ELEVATORS IN SOUTH AFRICA	39
THE WORLD POWER CONFERENCE. No. II. (Illus.)	40
CONVERSAZIONE OF THE INSTITUTION OF CIVIL ENGINEERS	44
SIXTY YEARS AGO	44
RAILWAY MATTERS	45
NOTES AND MEMORANDA	45
MISCELLANEA	45
LEADING ARTICLES—	
Heat Engine and Boiler Trials	47
Electric Transmission and Distribution	48
The Institution of Mechanical Engineers	48
STANDARD TESTS FOR HYDRAULIC POWER PLANTS	49
HYDRO-ELECTRIC PROGRESS IN SPAIN	49
THE ROYAL AGRICULTURAL SOCIETY'S SHOW, LEICESTER. No. III. (Illus.)	50
ELECTRICAL PROGRESS AND ITS UNSOLVED PROBLEMS	52
HIGH VOLTAGE ELECTRICITY TRANSMISSION. (Illus.)	54
THE QUARTER'S SHIPBUILDING RETURNS	54
INSTITUTION OF ELECTRICAL ENGINEERS	54
A NEW RACK LOCOMOTIVE. (Illus.)	55
THE MOTOR SHIP BELDIS	55
TRIALS OF THE MOTOR SHIP SWANLEY. (Illus.)	56
AUSTRALIAN ENGINEERING NOTES	56
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	57
Lancashire	57
Sheffield	58
North of England	58
Scotland	58
Wales and Adjoining Counties	59
CATALOGUES	59
CURRENT PRICES FOR METALS AND FUELS	60
FRENCH ENGINEERING NOTES	61
BRITISH PATENT SPECIFICATIONS. (Illus.)	61
FORTHCOMING ENGAGEMENTS	62
PERSONAL AND BUSINESS ANNOUNCEMENTS	62
CONTRACTS	62
PARAGRAPHS—	
Royal Society of Arts	62
Institution of Electrical Engineers	62
A New Fastening	62
The Royal Technical College, Glasgow	62
Fitting-up Bolts	62

THE ENGINEER.

JULY 11, 1924.

Heat Engine and Boiler Trials.

THE meeting held on July 3rd at the Institution of Civil Engineers to hear Captain Sankey's account of the scope and objects of the Heat Engine and Boiler Trials Committee, was a small one, but in its composition it was authoritative, and in its opinions singularly unanimous. The Committee is representative of many institutions and bodies, and has been in existence for a little under two years, examining and revising the reports of previous Committees appointed to inquire into the same subject. In order to secure as much preliminary agreement as possible, the Committee, before formulating either an interim or a final report, is adopting the policy of submitting some special point or points to public discussion. Its first venture in this direction was made last April, when, under its direction, Mr. G. J. Wells opened a debate on the standards of comparison to be used in connection with the thermal efficiency of internal combustion engines. On that occasion several divergent opinions and views were expressed, which the Committee will sift carefully before deciding to embody them in, or reject them from, its report. In the case of last week's meeting, however, opinion was so unanimous on the specific points submitted by the Committee for discussion that little labour and but small hesitation need be experienced in following and incorporating the views in the code. The Committee submitted for discussion three proposals. It was proposed that in dealing with the calorific value of a fuel, the gross or higher value should be used in place of the lower or net value prescribed in the earlier, 1913, code. It was proposed to omit from the boiler code the expression "pounds of steam evaporated from and at 212° F." It was proposed to make no use of the term "boiler horse-power." On a fourth point, the Committee sought the guidance of the meeting, namely, on the admissibility of water meters and steam meters in comprehensive trials for scientific purposes.

Scarcely a murmur, or a shadow of a murmur, of dissent was expressed against the Committee's proposals to adopt the gross value in the calorimetry of fuels, to abandon the time-honoured formula of evaporation "from and at 212° F." and to discourage the use of the all but meaningless term "boiler horse-power." Over the matter of steam and water meters, there was perhaps a shade less unanimity. It was generally agreed that the steam meter was inadmissible in scientific engine and boiler tests, on account of its liability to errors of an erratic and possibly large nature. The water meter was held by some to be admissible, provided it was carefully calibrated, both before and after the test. Several speakers expressed a distinct liking for the Venturi meter, while one or two urged that the only really satisfactory and accurate method of measuring the water consumption was by weighing it in tanks or in other direct manner. Most of those who spoke in favour of the Venturi meter, accorded it a high degree of accuracy—three-eighths of one per cent. was assigned to it by one speaker—but it was generally agreed that to secure the most accurate results with the instrument the water flow should be made as non-pulsating as possible by the use of a circulating or feed pump of the centrifugal rather than the displacement type. Some, as we have said, expressed a strong preference for the direct weighing of the water, but at least one speaker objected to this procedure on the ground that the figure arrived at might be open to a material correction for the presence of saline or other soluble matter affecting the density of the water. The possibility of error in the weights owing to an official tolerance and changes induced by wear and tear should also be borne in mind. It may, we think, be taken as a just account of the opinions expressed if we say that the Committee received strong encouragement to continue the inadmissibility of water and steam meters expressed in the 1913 code. Captain Sankey fittingly summed up this section of the discussion with the remark that as fluctuations in the flow always caused errors on the positive side, boilermakers should use meters, but engine builders should not! As regards the use of the gross or the net calorific value of fuels, the opinion was general that the net or "lower" value led to the assignment of too high a value to the thermal efficiency of the plant tested. It was also emphasised in favour of the higher value that it was capable of simple definition, and could be readily measured in a bomb calorimeter, whereas there were several possible definitions of the lower value, and the figure for it could not be determined without recourse to a chemical analysis of the fuel. Mr. Tookey, speaking on the subject from the point of view of internal combustion engineers, held that so far as the efficiency figure was concerned, it made little difference which calorific value was adopted. The lower value, he pointed out, had been in general use for a number of years, and he was afraid it would take some effort to win some of the manufacturers over to the higher value. To some engineers, the statement that practical unanimity was expressed in connection with the proposal to discard the time-hallowed expression "evaporation from and at 212° F." may appear startling and upsetting. But, on investigation, it will be found that the phrase is of far more commercial than scientific significance. It was introduced in the old days, as Captain Sankey reminded the meeting, when boiler pressures were being increased. The accompanying fall in the water evaporated per pound of coal fired—from, say, 10 lb. down to 7 lb. or 8 lb.—did not look well, and the expedient was adopted, very largely for the sake of appearance, of reducing the evaporation to a standard basis. Within recent years the extensive use of superheated steam has led to a similar situation. Mr. Low, the President of the American Society of Mechanical Engineers, interested the meeting last week with the statement that his Institution was recommending as the basis of comparison the equivalent evaporation from and at a pressure which was such that the latent heat which entered into the denominator in the reduction formula was exactly 1000, and not some such figure as 967.7. The pressure thus indicated is about 5 lb. absolute. Another speaker urged that evaporation should be expressed in terms of the thermal equivalent of a kilowatt-hour. The phrase "boiler horse-power" was also held to be objectionable, because of its purely commercial origin and its small significance under modern conditions. So great has been the advance made in boiler design since the term "boiler horse-power" was numerically defined, that in America, where it is largely used, boilers are frequently to be found working quite normally at 300 to 400 per cent. above their nominal boiler horse-power rating. Such a basis of designating the capacity of a boiler may still retain a small amount of usefulness as a catalogue description; but for the purpose of scientific or commercial acceptance tests, it is next to meaningless. It is a quantity arrived at solely by means of the foot-rule, and is calculated for a standard pressure and a standard evaporative performance that long ago became antiquated.

It is with great pleasure that we notice a strong determination on the part of the Committee to eliminate from its code all terms of a false, doubtful or misleading character. We earnestly hope, however, that in its endeavour to establish the code

on a sound scientific basis, it will do nothing to encourage the far too common practice of carrying the results of boiler and engine trials to the third or fourth place of decimals. With each individual item open to a material error, the inaccuracy of the figure arrived at for such a quantity as the coal consumption per brake horse-power-hour, may be considerable, and must always involve a large element of uncertainty. It is gratifying to note that the Committee intends to prepare a statement showing the degree of accuracy to be expected in making any single measurement and the resultant accuracy when a series of such measurements is combined. Two sets of figures will be given, one relating to measurements made for the purposes of commercial trials, and the other to measurements taken during the course of comprehensive scientific trials. The whole subject of testing heat engines and boilers is one of very great importance, both to manufacturers and to those concerned with the scientific study and development of prime movers. It cannot be properly considered solely from either side, and indeed it is doubtful if it can be placed on a satisfactory standardised basis unless the standardisation receives international acceptance. It is perhaps too ambitious to hope that the code now being prepared by the British Committee will become generally accepted throughout the world, for other Committees are at work on the same subject in other countries, notably in the United States. Full advantage, however, should be taken of all possible opportunities to secure common agreement. Where such agreement cannot be reached, the code should contain a statement that will place those using it on their guard against any injustice being done them by the adoption abroad of a more favourable, though possibly less just, standard than that adopted by the British Committee.

Electric Transmission and Distribution.

THE papers covering power transmission and distribution presented at the World Power Conference on Monday and Tuesday of this week were on the whole interesting and instructive. Although the discussions were not all that could be desired, the presentation of the ideas of engineers belonging to different countries should, we think, ultimately prove a distinct benefit to those who are engaged in power transmission and distribution work. Perhaps the most satisfactory fact brought to light was that at least two prominent British electrical engineers, namely, Dr. Ferranti and Mr. Merz, realise that simplicity in electrical engineering is a thing to be aimed at. It has long seemed to us that electrical engineering is getting far too complicated. Although innumerable papers have been read on all sorts of intricate schemes claimed to save money or to offer some other important advantage, rarely has anyone made a protest against the multiplication of "gadgets" in power systems. We remember that on one occasion, however, a speaker at a meeting at which a paper on protective apparatus was read did express himself in rather forcible terms concerning this question of eliminating complication. The speaker was Mr. E. T. Williams, whose remarks will be found on page 779 of the "Proceedings" of the Institution of Electrical Engineers for July, 1922. "During the past twenty-five years," he said, "I have seen device after device installed in power stations and then put out of operation because it was found that the troubles due to such devices were far greater than those which they had been installed to prevent. I maintain and have maintained for a long time that we should aim at greater simplicity." With this view we find ourselves in entire agreement. Mr. Charles Merz shows in his paper and Dr. Ferranti called attention to the same fact at the conclusion of the meeting over which he presided on Tuesday last that the capital cost of transmission and distribution is, as a rule, as much as that of the generating station or stations, and if fuel be omitted the operating costs of transmission and distribution are nearly as much as those of generation. Obviously, then, every possible step should be taken to reduce expense on the transmission and distribution sides of electric power undertakings. Continuity of supply is, of course, of first importance, but there is such a thing as carrying protection too far and so involving unnecessary expense.

No one can fail to appreciate the ingenuity that has been exercised in the design of modern switchgear capable of breaking circuits carrying very large amounts of power, and the amount of clever work that has been put into the development of modern converting machinery. Yet there is no doubt, we think, that there is room for simplification and a reduction in capital expenditure. Conditions in different countries differ so widely that it is difficult to make comparisons and to arrive at the ultimate effect of different ideas. Nevertheless, it appears that on many parts of the Continent of Europe the desire to secure simplicity is more pronounced than it is elsewhere. All the automatic gear that is being introduced in America and to some extent in this country with a view to saving labour does not seem to be considered necessary on the Continent. The aim of continental engineers appears to be to supply current to industrial and domestic consumers and to the railways in the most direct manner possible, and to cut down the number of sub-stations.

There are many points in connection with the series of papers mentioned which might have been discussed far more fully than they were at the Conference. A contribution which is worthy of the attention of those who are interested in frequency changing is Professor Paul Müller's paper on "The Frequency Converter," which is a machine designed to convert 50-cycle current into 16⅔-cycle current. Tests on a relatively small machine have shown that the efficiency is considerably higher than that of a frequency changer of the ordinary type, and the machine is also more simple and cheaper to construct. Among the papers dealing with schemes for reducing costs was one by Messrs. J. S. and W. E. Highfield on "High-voltage Direct-current Generation and Distribution of Electrical Energy," but in spite of all the advantages claimed for the scheme, which is in the experimental stage, the paper failed to arouse any discussion. The position with regard to the scheme is, however, pretty clearly stated in the paper by Mr. Merz, who says that so long as no direct-current apparatus equivalent to the static transformer is available, reversion to the use of direct-current for general transmission is unlikely. If the authors can show that their transverter is thoroughly reliable under all conditions of service, direct-current transmission may, as Mr. Merz states, meet certain requirements; but we rather fancy that engineers will be in no haste to install an arrangement with ten 10,000-volt commutators for the transmission of large quantities of electrical energy. What the inventors ought to do if they desire central station engineers to take an interest in their machine is to connect it up to a really large power station and show the effect of short-circuiting it. Whilst we fully realise that the development of the transverter has involved a great deal of thought and skill, it is folly to suppose that direct-current transmission will be universally used in the future. The authors admit in the early part of the paper that they are dealing with an engineering method which may be regarded as removed from practical application at the present time, and they make no claim that the difficulties of applying high-tension direct current for transmission have been or can be solved. Our own opinion is that high-tension direct current will eventually be produced by some sort of thermionic rectifier, and that the use of revolving commutators at the sending end, at any rate, will be unnecessary. We were interested to learn from Mr. W. E. Highfield that the efficiency ultimately expected is 97½ per cent., which is an improvement on the efficiency shown by the curve which we recently published. Another interesting piece of information which Mr. W. E. Highfield gave at the meeting was that the makers expect to be able to produce transverters in sizes up to 10,000 kilowatts. That would be a fair-sized machine, although small in comparison with the German 60,000-kilowatt transformers. It is to be remembered in connection with all new schemes that very large loads indeed will have to be dealt with in the future. It has been suggested that the transverter will be useful for linking up power stations, but the question of tapping the line should not be overlooked. During the course of a discussion on a paper entitled "Interconnection of Alternating-current Power Stations," read before the Institution of Electrical Engineers in 1922, Mr. P. V. Hunter pointed out that an interconnector should also act as a network feeder. In the case of alternating-current transmission and distribution it would, of course, merely be necessary to install simple and efficient static transformers at the points of connection; but with direct-current transmission transverters would have to be used and men would, we presume, be needed to look after them. Static transformers enable sub-stations to be erected in the open, but we cannot conceive an outdoor transverter sub-station. The great value of the static transformer in electrical engineering is not, we fear, always appreciated. It has been in use for so many years and it has done its work so well that it is not until we attempt to replace it by something else that its great merits really become apparent.

Marked progress, it appears, is being made in the development of high-pressure alternating-current cables. Mr. Merz states in his paper that it is probable that by using single-core cables 132,000-volt circuits may be carried underground with safety and reliability, whilst Major A. M. Taylor explained during the course of the discussion that a length of his special cable with intersheaths has been made and tested, and that a working pressure of 220,000 volts can be adopted. We do not know whether it will be possible to run cables along the railways as Major Taylor has suggested, but if that could be done the question of employing super-pressure cables for long-distance work seems worth considering. As far as capital cost is concerned, it can easily be shown that transmission lines are better than cables. In Great Britain, however, there are obstacles besetting overhead lines, such as excessive wayleave charges, and unless these obstacles can be overcome the question of running super pressure cables along the railways may be worth looking into. The railway companies, it seems, are to be closely linked up with the electricity supply business. They are going to take all their current from the super power stations at a periodicity which is not always the best for traction work, and perhaps they will also be good enough to take charge of the supply undertakings' cables and so remove some of the difficulties that exist in connection with the use of overhead wires.

The Institution of Mechanical Engineers.

IN view of the fact that many foreign and country members desired to pay a visit to the British Empire Exhibition, the Council of the Institution of Mechanical Engineers decided to forego the usual summer meeting and merely to arrange for the members to foregather in London for a few days. This they did, and on Monday evening a very successful dinner, under the presidency of Mr. W. H. Patchell, was held in the Connaught Rooms. There were of necessity a few speeches, amongst which two by American guests, Mr. Low and Mr. Freeman, must be mentioned; but the general idea of the dinner was to reduce speeches to the minimum and to encourage intercourse between the members and guests. The plan worked out admirably and was thoroughly approved on all sides. In order to carry it out a departure was made from the usual "school-treat" arrangements, many small tables being provided, so that free circulation was possible. A band played during dinner and again after the speeches, when the "dinner" rapidly became a "*soirée;*" introductions went on at high speed, and the members, visitors, and guests became acquainted with each other with a rapidity which would have been quite impossible had the usual course at these banquets been followed. It is to be hoped that this admirable scheme, introduced by Mr. Patchell, will become the accepted course at future summer meetings, and that, as on this occasion, the dinner will be held on the first night of the gathering, so that friendships may be established from the beginning. There can be no doubt that there is a greater susceptibility—for we are all human—to make new acquaintances after a good dinner than at other times, and we think that the success of Monday evening has shown that it is more effective in this respect than a conversazione, which is generally regarded as the proper means to that end. There are some people we know who like to listen to "post-prandial orations," particularly by "star turns," but it is a matter for consideration if after-dinner speaking has not been carried too far. The repose that long speeches enforce may encourage digestion, but they interfere with the pleasures of conversation, which are the right and natural pendants of a good menu, and we were glad indeed to see a real effort to break away from the traditional course. With regard to the rest of the meeting we need only say that it was continued by a quite informal gathering without papers or speeches at the Exhibition, where a very large party gathered for luncheon on Tuesday. In the circumstance no better kind of summer meeting could have been devised.

IT is announced that an agreement has been concluded between Portugal and South Africa, under which goods for the Transvaal may be landed at Lourenço Marques and exported again from there inland free of all duty.

Standard Tests for Hydraulic Power Plants.

ON Saturday morning the draft standard test code for hydraulic power plants prepared by a joint committee of the Institutions of Civil and Mechanical Engineers was submitted for discussion and criticism at the home of the second-named body in London. This report was presented and discussed at a joint meeting of the two Institutions held at the end of March—see THE ENGINEER for April 4th, 1924. On Saturday, with certain additions and alterations suggested during the course of the previous discussion, it was re-submitted for debate with the hope that overseas engineers in London for the World Power Conference would attend the meeting and contribute to the proceedings. That hope was not disappointed. The meeting, in spite of its unusual hour, was well-attended by members and visitors from abroad.

Mr. Patchell, in opening the proceedings, remarked that in America a standard hydraulic power test code already existed, and expressed the opinion that it was very desirable that there should be as much uniformity as possible between such national codes. Professor S. M. Dixon briefly introduced the draft of the code prepared by the joint committee of which Professor A. H. Gibson was chairman, and he a member. He explained that nothing in the code was as yet fixed and that the committee was still anxious to receive suggestions for its improvement.

Mr. Evan Parry said that he had had an excellent opportunity of studying the subject, as he was not only a member of the joint committee of the Institutions of Civil and Mechanical Engineers, but also on the committee of the World Power Conference and the sub-committee of the International Electro-technical Commission. At the meeting of the World Power Conference on the previous day it became evident, he said, that there was a distinct desire for co-operation among various nationalities in the matter of testing, and it was suggested that that co-operation might be attained through the services of the International Electro-technical Commission. In view of what he had heard from Dr. Semenza of the test code drawn up by the Electro-technical Commission and the fact that it was not desirable to duplicate investigations of this kind, he thought that the best course would be to refer the drawing up of an international test code for hydraulic plant to the International Commission, to ask it to amplify its existing code, bring it up to date, and modify it, if necessary, to conform with the wishes of other nations. It was fairly evident that it would not be difficult to come to a general agreement, as codes had already been drawn up by the International Commission, the American Society of Mechanical Engineers, the joint committee in this country, and by German engineers, while there was the paper No. 399 before the World Power Conference, which also dealt with the subject. On comparing all these various authorities it was found that there were very small differences in their decisions, and that those differences should be easy to harmonise. The differences were rather matters of expediency than actual differences of opinion on matters of fact. Thus, for instance, no one could dispute what was the effective head on a hydraulic plant, but it might be debated whether or not the velocity head in the draft tube should be taken into account in determining the efficiency of the turbine.

Mr. Sheppard, of the Niagara Falls Power Company, said that in one or two respects the committee had improved upon the code of the American Society of Mechanical Engineers, but there was no essential difference between the two codes, such as there was being largely confined to matters of phraseology. He was not satisfied with either code in the treatment of the draft tube. Where, he asked, did the draft tube end and the tail race begin? It was difficult, he argued, to separate the losses in the draft tube from the losses in the runner, and the wheel case. The whirl in the water in the draft tube made it difficult to determine the amount of energy in the flow. It was important to remember in discussing the code as a whole that those for whom it was devised were concerned with actual physical factors rather than with some specific means of measuring them. Except in the case of direct volumetric measurements—and such measurements were difficult to carry out when large volumes of water were involved—the code was based on the figures given by particular methods of measurement. It was most desirable that the probable errors of such methods should be clearly stated in the code.

Dr. Marco Semenza pointed out that as long ago as the year 1913 the International Electro-technical Commission, of which body he was now the president, had published some test codes and then found that considerable interest was shown in their extension to cover prime movers. The Institution of Mechanical Engineers was approached in connection with the subject, but the Institution decided that it was not a matter of urgency. The Commission, however, organised committees of members all over the world, with a head office in London, and made a start by setting out a number of definitions. These definitions were accepted and put into application at a meeting in Berlin in 1913. It was thought that these definitions were definitely established, but as a matter of fact they were adopted in only a very few countries. He desired to know whether the joint committee wished to set up a standard code which would be acceptable in all the countries of the world, or would only be welcomed in a few. There were two ways to attack the work of drawing up a really international code. One was to set up an International Commission for that specific purpose and the other was to take advantage of existing organisations. He was very pleased to offer for the latter purpose the services of the International Electro-technical Commission, which already had an extensive organisation. It would be only necessary to reinforce its national committees by experts on hydraulic engineering, and these committees would then appoint delegates to discuss the drawing up of a testing code through the intermediary of the head office.

Mr. John R. Freeman, a past-president of the American Society of Mechanical Engineers, stated that for the past three years he had been endeavouring to induce the United States Government to establish a large-sized hydraulic laboratory. The cost involved would be in the neighbourhood of 200,000 dollars, and the plans were prepared for dealing with flows by direct volumetric measurements up to 600 cubic feet per second. The laboratory, he held, would be a measure, not of expenditure, but of economy; but so far the Government had not found it possible to assist the scheme for its establishment. He hoped, however, that it would be carried out in the near future and that it would be possible to make experiments on large weirs—say, 5ft. to 6ft. deep by 15ft. long—and in other directions to conduct laboratory research work of international importance. Referring to the alleged difficulty of measuring the whirl in draft tubes, he stated that such whirl could be very easily evaluated by means of a modification of the Pitot tube consisting of a main tube 1in. in diameter fitted with a large number of small tubes. He had found it quite possible with such a device to measure the whirl in penstocks up to 9ft. in diameter. The whirl of the water in a draft tube was a good feature, as it resulted in the diffusion of the water and an increase in the efficiency. In the draft code under the title "Measurements of Head" it was stated that any pressure opening in the wall of a pipe or passage should not exceed about ¼in. in diameter. He desired to know the reason for this restriction. Piezometer orifices up to 4in. in diameter had been used successfully, and he himself would not hesitate to use a 6in. orifice if necessary. It was important, however, that there should be orifices on both sides of the tube and spread out over a definite length, for a stationary pressure wave might exist in the flow that would not be detected by a single orifice or by two placed diametrically opposite each other. Discussing the Pitot tube and the variation—up to 4 per cent. according to the draft code—that had been found in its coefficient, he remarked that the anomaly was to be traced to a defect in the design of the Pitot tube orifice, whereby it was made more difficult for the water to flow in one direction than in the other.

Mr. Challies, of Canada, said that so far as Canada was concerned the settlement of a standard system of testing hydraulic plant was of the greatest importance. Not only was there already a vast amount of water power developed, but the plant was being added to at the rate of a quarter of a million horse-power a year. So far Canadian engineers had largely followed the lead of the United States in the testing of turbines and had found the scheme satisfactory. He suggested that if the joint committee desired to have the considered opinion of Canadian engineers on the draft test code the Canadian engineering institutions would be very pleased to do all they could to help.

Professor van Iterson, of Holland, said that the chemical method of measuring the flow of water in open channels could not be completely standardised, for the results which it gave were influenced by the climatic temperature. Between tests carried out in the West Indies and in Europe differences of as much as 2 per cent. had been detected in this method. It was therefore essential, he held, to specify the temperature at which the test was to be conducted.

Mr. W. M. White, of the Allis Chalmers Company, said that he did not thoroughly understand what the code covered and for what specific purpose it was put forward. Was it, for instance, intended to provide a means for determining efficiencies on scientific lines or to form a basis for bargaining between buyers and sellers? In other words, was the code drawn up for the benefit of scientific societies or for the hydraulic machinery trade? In the code various suggestions were made as to the methods of testing and as to the constants which should be adopted; but what he would like to see was something more in the nature, for instance, of a clause stating that if the water was measured by a weir the measurement *must* be carried out in accordance with the definite instructions prescribed in the code. As a manufacturer he did not care what coefficients were adopted so long as they were rigidly accepted and adhered to and the conditions of the test were expressed in the imperative tense. In the case of five 56,000 horse-power turbines which he had tested there was a bonus of 6000 dollars for every 1 per cent. improvement in efficiency. Under the American code of testing a claim for 50,000 dollars was clearly established, but with the vague wording of the draft code of the joint committee he doubted if he would have succeeded in getting any award at all.

Dr. Peter Thomer, of Munich High School, held that it would be very difficult to lay down rigid rules such as Mr. White had asked for, since local conditions varied too greatly.

Mr. N. G. Jessen, of Christiania, thought that too much prominence was given in the code to questions of hydraulic efficiency. An international code should define methods of measuring speed and pressure variations.

Mr. G. A. Orrok, of the American Society of Mechanical Engineers, asked Mr. White whether, although he had said that the thing of first importance was the definite establishment of coefficients, he was not also interested in securing that the water was being used in the most efficient way possible. To this Mr. White replied that it was naturally desirable that the coefficients and constants should be as accurate as possible. While, however, the progress of research might result in a revision of the coefficients, it was essential that the test code should be so worded that the conditions accepted at the beginning of a contract would be binding until the work was completed.

Mr. F. R. Low, president of the American Society of Mechanical Engineers and chairman of that body's Hydraulic Test Code Committee, expressed the hope that those interested in the subject in this country and in his own might be brought to work together and that an international joint committee might eventually be formed.

Mr. C. Le Maistre, secretary of the British Engineering Standards Association, said that he was especially interested in the drawing up of the code on account of the organisation which it involved, a subject with which he had had considerable experience. He was afraid that there was a possibility of considerable overlapping if the various committees were not brought into close touch with one another. Abroad there were in existence a number of standards committees, and there had recently been a general meeting in Zurich which had provided means of readily and economically getting into touch internationally for purposes of scientific investigation.

Mr. Evan Parry endeavoured to answer Mr. White's question as to the precise object of the code. Its object was, he said, to obtain a satisfactory basis on which to guarantee efficiencies. Differences of 3 or 4 per cent. in the guaranteed efficiency had been known to have been caused by differences in the definition of net head.

Professor Dixon, having expressed his thanks to those who had taken part in the discussion and having invited further discussion in writing, Mr. Calvin Rice, the secretary of the American Society of Mechanical Engineers, said he thought he could speak for all the American and Canadian institutions in assuring British engineers that they would gladly work with them in an engineering undertaking of the nature covered by the draft code. He suggested that rather than wait for voluntary suggestions and opinions, it would be desirable if the two British institutions wrote officially to the overseas bodies asking them for information. A resolution to that effect was proposed by Mr. Patchell, and it was agreed to transmit it to the joint committee.

HYDRO-ELECTRIC PROGRESS IN SPAIN.

THE RIO DURCAL INSTALLATION.

IN an article contributed to the *Revista de Obras Publicas* by Sr. Tomas Bioso, engineer of highways, a description is given of a power installation on the Rio Durcal, in the Province of Granada, which was completed at the end of last year and is now working. A fall of 758 m. (2487ft.) is utilised, the only installation in Spain with a greater fall being that of Capdella, 830 m. (2723ft.). The water flows from the Sierra Nevada and is impounded in a reservoir of 4000 cubic metres capacity (140,000 cubic feet). The flow at present utilised is 400 litres per second (14 cusecs), but it is intended that 3000 litres per second (106 cusecs) shall be made available, if necessary, in the future. The channel which feeds the reservoir is partly in open cut and partly in tunnel and is 9580 m. (31,420ft.) in length. Another reservoir of about the same capacity has been formed near the outlet of the power-house, in order to safeguard various established water rights, including some very old irrigations. By this means the *regimen* of the river is maintained, whatever be the rate at which the power water is being used. The pressure pipe from the upper reservoir to the power-house is 500 mm. in diameter (say, 19¾in.) in lengths of 12 m. (say, 39ft.), the wall thickness ranging from 7 mm. to 23 mm. ($^{9}/_{32}$in. to $^{29}/_{32}$in.). It is without expansion joints and is buried throughout its length, 2136 m. (say, 7000ft.).

There are two groups of turbines and alternators, each of 1700 kilowatts at 3000 volts. Two groups of transformers raise the potential, in one case to 25,000 volts, for transmission to the network of tramways and electrical railways in and around Granada, and in the other case to 60,000 volts for transmission to Almeria for general purposes. For the supply for the electrical railway from Granada to the village of Durcal, 35 kiloms., a battery of accumulators, the largest in Spain, has been installed. It comprises 580 double elements with a capacity of 444 ampère-hours at 1200 volts. The works were begun in August, 1921, and completed in December, 1923. The cost of the battery of accumulators was 270,000 pesetas (say, £8,000), and the cost per horse-power installed was about 850 pesetas (£26). The works were designed and carried out by Dr. Alfredo de Velasco.

The Royal Agricultural Society's Show, Leicester.

No. III.*

MESSRS. WATKINS AND CO., Leicester, have an exhibit consisting of a selection of high-speed woodworking machines, all of which are fitted with the firm's latest improvements. These include a 20in. saw bench fitted with rising and falling table mounted on a heavy circular slide, the spindles running in ball bearings. A 32in. circular saw bench has been designed to meet the Home Office regulations. The heavy-spindle vertical moulding machine shown is suitable for all kinds of straight or irregular shaping and is fitted with an efficient tenoning attachment. A new model shown is a 15in. combined surfacing and thicknessing machine. This machine has been specially designed for the building trade and has several new features. All the feed gears are totally enclosed and run in an oil bath, and the machine has a safety circular cutter block arranged to take moulding irons; the spindles run in ball bearings.

The 7-ton motor road roller, made by Ruston and Hornsby, Limited, of Lincoln, which was illustrated in Fig. 5 in our issue of last week, is of the tandem pattern. It is propelled by a two-cylinder vertical engine rated at 20 effective horse-power and placed longitudinally in the frame. The drive is taken from the engine to the gear-box through a short shaft with flexible disc couplings at each end, two clutches being provided on the gear-box, one for forward and one for reverse, so that it is not necessary to disengage any gears when reversing. This feature is an advantage in road rollers, which are called upon to operate as frequently in one direction as in the other. Three travelling speeds are provided for in the gear-box, and the transmission from the latter to the rollers is by an enclosed roller chain. The engine is fitted with high-tension magneto ignition, a governor and a water circulating pump. Petrol is used for starting purposes, after which the engine operates on paraffin. The radiator for water cooling is placed at the rear of the machine, and there is a fan driven by a belt from a shaft running from the gear-box to the rear, this shaft being used for starting by means of a crank handle. The frame of the roller is built up of rolled steel channels with strong cross members. The steering is effected by a worm and worm wheel and chain similar to that adopted in the case of steam rollers. The road speeds are 2½, 1, and ½ mile per hour, and the width rolled 4ft. Messrs. Ruston and Hornsby's other exhibits include their well-known petrol-paraffin engines from 2½ to 7 brake horse-power, electric lighting sets, pumping plants of the centrifugal pattern, a gas engine with suction gas plant, cold-starting oil engines, an internal combustion locomotive operating on paraffin, the British Wallis tractor, a traction engine, and other purely agricultural implements, such as ploughs, drills, binders, and mowers.

The exhibits by Marshall, Sons and Co., Limited, Gainsborough, cover a very wide range, including road rollers, portable engines, steam tractors, oil engines, from 8 horse-power to 100 horse-power, and thrashing machines. The road rollers are of 8 and 10 tons nominal weight, and the makers have succeeded by "production" methods in arriving at a design which permits of interchangeability of all component parts, even to the boilers, with the minimum amount of skilled labour. The engines have piston valves, the crank shafts have dust-proof ring lubricated bearings, and, by the adoption of radial valve gear, fewer parts are necessary than with the link motion, while larger bearing surfaces are provided. The road wheels have both hubs and spokes combined in a substantial steel casting. The rims of the rollers are renewable, and the driving wheels are interchangeable. The latter feature is an advantage in that there is some difference in the wear of the two wheels when scarifiers are hauled, and by changing the wheels the wear is equalised. A four pinion differential gear is fitted, and the fire-box is devoid of roof bars, suspension bolt and longitudinal stays, an arrangement which facilitates cleaning. The front plates of the boilers are reinforced by T section stiffeners, and the smoke-box tube plates have transverse corrugations which strengthen the structures. The fore part of each boiler has a flanged bolted joint with machined surfaces, connecting the smoke-box to the barrel. This construction facilitates conversion to a haulage engine or *vice versâ*, and also enables the smoke-box to be replaced at any time without involving further heavy expenditure for new boiler plating.

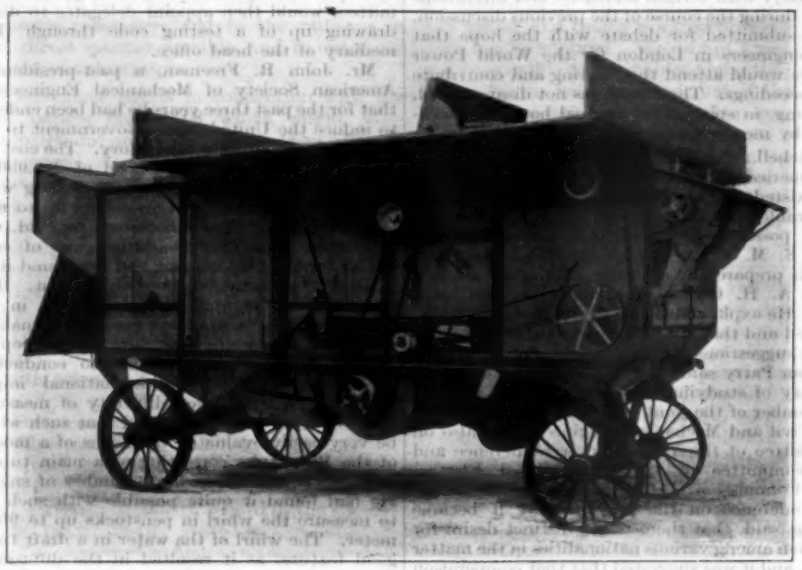


FIG. 7—STEEL THRASHING MACHINE—MARSHALL, SONS AND CO.

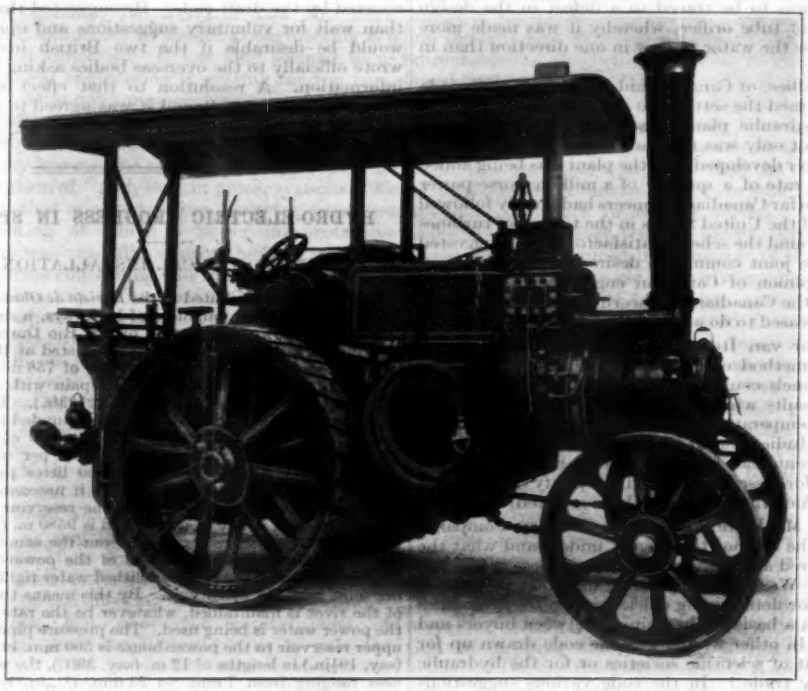


FIG. 6—COMPOUND STEAM TRACTOR—MARSHALL, SONS AND CO.

The Marshall compound steam tractor, of which we give an illustration—Fig. 6—operates on the three-shaft principle, and has a boiler built on similar lines to those of the road rollers. It is constructed for a working pressure of 200 lb. per square inch, and the engine is carried on a planed steel fixing riveted to the boiler. The cylinders are 4½in. and 8in. diameter by 8in. stroke. The valve mechanism is of the radial gear pattern, each slide valve being operated by a single excentric to obtain equal distribution of steam at both ends of the cylinders. The transmission gears, with the exception of the last motion, are all machine cut and run in oil. The engine is designed for road speeds of 2½ and 5 miles per hour, and is carried on outside laminated springs. Lubrication of the interior of the cylinder is by means of an automatic oil pump provided with ball valves. A Pickering governor is fitted to enable the engine to drive fixed machinery.

Marshall's oil engines all operate on the two-stroke principle, the ignition being partly by the heat of compression and partly by hot bulb on the cylinder head. They are made for powers from 8 to 450 brake horse-power.

Fig. 7 represents a 4ft. 6in. by 4ft. steel "finishing" thrashing machine shown by Marshalls. In this machine the frames are built up of steel sections and the sides and ends of steel sheets. The thrashing drums are of the usual "beater" type, with bar and wire concaves and the principal shafts are carried in self-aligning ball bearings. The dressing and grading appliances follow well-known Marshall lines, and three qualities of grain can be delivered simultaneously. These steel machines have fewer working parts than those made of wood, as "shaker" cranks have been eliminated. Nor are there any inside bearings. The steel thrashers are designed specially for operating in conjunction with oil tractors, or stationary oil engines, while they are lighter and stronger than the wooden machines. The largest machine of the series has an output of 1500 bushels per day of 10 working hours.

FIG. 8—RAM PUMP—TANGYE

Tangyes, Limited, Birmingham are represented by several internal combustion engines, which include a 35 horse-power heavy oil engine of the horizontal

* No. II. appeared July 4th, 1924.

pattern and designed for starting from cold. In this engine the cylinder casing is cast with, and forms part of, the bed-plate. The combustion chamber is a separate casting and the valves are arranged to give easy access for examination and cleaning purposes. The engine has a hard cast iron liner, which can easily be removed for renewal purposes. The fuel pump and operating gear are of somewhat novel design. On the upward stroke of the pump plunger, oil is drawn through the suction valves, and on the quick down stroke it is forced through the delivery valve and connections to the spray maker on the combustion chamber. The stroke of the pump plunger is in proportion to the work performed by the engine. At the moment the fuel oil has to enter the combustion chamber it raises a small piston and valve in the spray maker against the action of a strong spring, which then allows the fuel oil to pass through a pulveriser which, having a number of fine tangential grooves, gives to the oil a rapid whirling motion. The nipple of the spray maker is of special construction to prevent oil drip and accumulation of deposit when heavy grade oils are used. A combined fuel heater and filter which is kept at a suitable temperature by allowing exhaust gases to circulate around it, is provided. Ignition is effected by the heat of compression assisted by the heats of the walls of the combustion chamber and an internal heating sleeve.

This firm also shows a 10 horse-power horizontal oil engine in which the cylinder jacket, combustion chamber and the exhaust valve box are cast in one piece. This engine is fitted with water injection to the evaporiser, a small quantity of water being drawn from the cylinder jacket through a snifting valve on each charging stroke. The ignition of the explosive charge is effected at starting by means of an external tube heated by a blow lamp which is arranged under the evaporiser. The governor works on the hit-and-miss principle. Two vertical petrol engines, of 7½ and 5½ brake horse-power and mounted on skids, complete this firm's exhibits in this department. These engines have been specially designed so that they can be entrusted to unskilled attendants. They have a sensitive governor operating on the throttle system and magneto ignition with a variable timing device. A vertical single ram pump of simple design, shown by Messrs Tangyes, is illustrated in Fig. 8. This pump has been specially produced for farm and estate purposes, and is made in three sizes. As will be seen, it is of simple and substantial construction. It is fitted with a fly-wheel for belt driving.

This pump is designed for working against heads up to 150ft., and is made in three sizes, namely, 3¾in. by 3in., 4¼in. by 4in., and 5¼in. by 5in., the respective deliveries being 460, 1050 and 2100 gallons per hour when making 90 revolutions per minute. The rams are of cast iron and the valves of india rubber with brass guards, Muntz metal spindles and brass seats.

One of the exhibits of Clayton and Shuttleworth, Limited, Lincoln, was a 10-ton road roller of improved design—shown in Fig. 9. On this machine we noted that the change speed gear is now operated by one lever giving increased simplicity and ease of operation, while preventing two gears from being put into operation simultaneously, even should the locking gear fail through breakage. The steam-driven auxiliaries, such as the injector, water-lifter and sprayer steam valve are all of the wheel type arranged in a convenient position for the driver so as to give ease of manipulation. Ring oilers are fitted to the crank and first motion bearings, the second motion and hind axle bearings having drip-feed lubricators. The feed pump, while of ample capacity to supply water to the boiler under all conditions, is not so large as to make the regulation of the feed difficult to control by the driver. Messrs. Clayton and Shuttleworth also show steam traction and portable engines, a 6-ton undertype steam wagon, crude oil engines from 10 to 35 brake horse-power, thrashing machines and a steam power chaff-cutter.

One of the Royal Agricultural Society's silver medals was awarded to John Fowler and Co. (Leeds), Limited, for an original agricultural two-wheel tractor, of which we give illustrations in Fig. 10 and 11. In this machine the driver sits on the implement which is being hauled and controls the tractor by means of a pair of leather reins, just as in driving a team of horses. For instance, by letting the reins go forward the tractor is put into motion; pulling them backwards stops the machine and applies the brakes, pulling them further backwards to the extreme puts in the reverse gear; while a turn of the wrist and a light pull on either of the reins will cause the tractor to steer in either direction, both when the tractor is moving or is stationary.

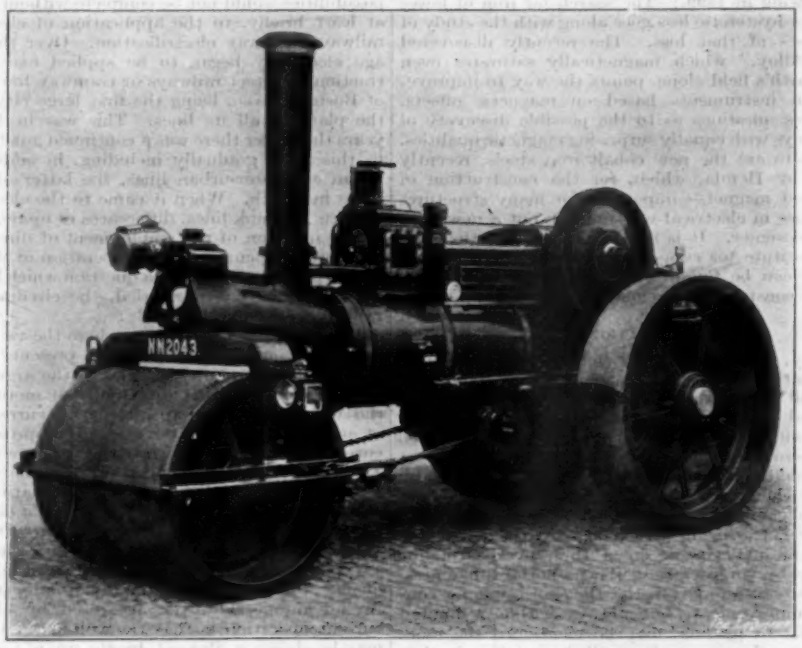


FIG. 9—TEN-TON ROAD ROLLER—CLAYTON AND SHUTTLEWORTH

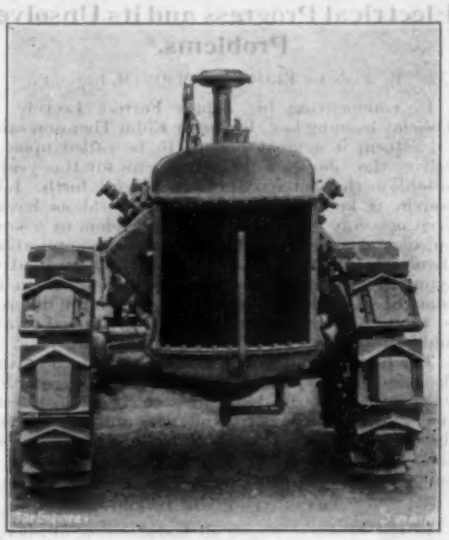


FIG. 11—REIN-DRIVE TRACTOR—FRONT VIEW

The steering gear is of the reversible worm type, and is put into action by two friction drums which make peripheral contact with the engine fly-wheel. Being a two-wheeled machine the whole of the weight is utilised for adhesion of the road wheels, which are of the rolling pad type, the pads forming a track for the wheels to roll on. The engine has two water-cooled cylinders arranged V-wise. It has ball bearings on the crank shaft and roller bearings on the connecting-rod ends. The pistons are lubricated by means of an automatic force feed lubricator. The engine speed is controlled by a governor, and the ignition is by means of a high-tension impulse magneto. The clutch is free from end thrust, and can be adjusted while the engine is running. A power pulley for driving stationary machinery is provided at the rear of the crank shaft extension, and is put into or out of action by the main clutch and the pair of reins. The main frame and gear-box are an integral casting of steel of great strength, and the transmission gearing runs in ball bearings in oil. A telescopic tubular draw bar is used to couple the tractor to the implements, and permanent brackets on the latter allow of a change being made from one machine to another quickly. Draw bar attachments are provided for all types of farm machines connecting to standard bolt holes in the latter. A 2-ton trailer is supplied with each tractor for use when the latter is not in use for hauling implements. We are informed that this tractor is the outcome of years of exhaustive study and practical tests. The inventors have certainly ap-

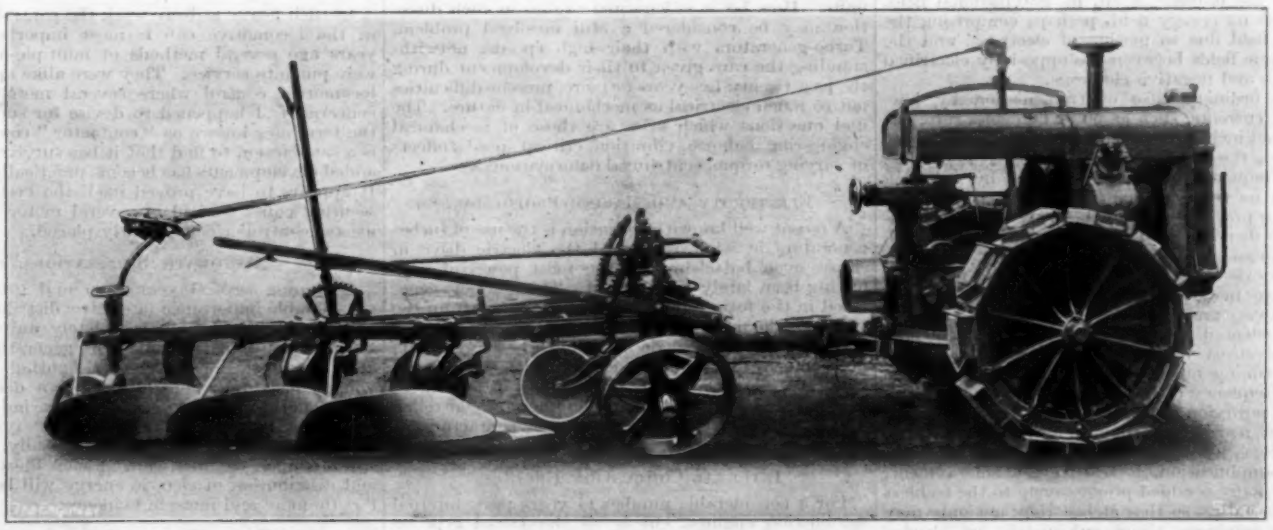


FIG. 10—TWO-WHEEL, REIN-DRIVE AGRICULTURAL TRACTOR—JOHN FOWLER AND CO.

proached the farm tractor problem from a different angle from that generally adopted, as the operator is able to give better attention to the adjustment of the implement than when seated on the tractor.

Messrs. Fowler also exhibited a 16in. by 9in. stone crusher that operates on a system which, as far as we are aware, is unique. It is carried on four road wheels made of light pressed steel revolving on fixed shafts, which are connected to the main frame, in the rear by U bolts and in the front by "goose necks" on to centre pivoted castings, each shaft connection being easily detachable to enable the crusher to be placed on the ground.

Electrical Progress and its Unsolved Problems.*

By Professor ELIHU THOMSON, M. Inst. C.E.

IN commencing his James Forrest Lecture on Tuesday evening last, Professor Elihu Thomson said: "I esteem it a great honour to be called upon to deliver the 'James Forrest' Lecture for this year—notable as the centenary of Lord Kelvin's birth. Lord Kelvin is known throughout the world as having been not only one of the greatest leaders in science, but also as a most able exponent of the applications thereof in practice, as in engineering. He had no sympathy with the attitude, not uncommon in his time, of so-called pure scientists, of being indifferent to the possible service which science, applied to arts and industries, could be to humanity at large."

The first portion of the Lecture was devoted to a discussion of the present state of knowledge regarding what may be termed Nature's electrical manifestations, such as thunderstorms, the aurora, magnetic disturbances, &c. Then, turning to other questions, the lecturer first of all directed attention to transmission of energy:—

TRANSMISSION OF ENERGY.

In the broadest sense, all transmission of energy, whether by movement of masses or particles, or by conduction of heat or convection or by radiation, as in the case of heat, light, wireless or other space waves, or by electric currents or shifting fields of magnetism, must now be regarded as fundamentally electric, since all properties of matter are now seen to depend on the electric constitution of the atoms and molecules, composed, as they have been shown to be, of negative electrons, and positive nuclei or protons. More than twenty-five years ago I ventured the assumption that the future would reveal the electric ions as the fundamental things, amounting in their relations for all actions or properties in Nature. I have therefore a considerable sense of gratification that within my own life we have seen so much confirmation of these views, not forgetting, however, that the greatest of unsolved problems still lies in the mystery of positive and negative charges, or in electrification itself.

We are now compelled to regard every particle of what we call matter—a system or assemblage of systems of electrons—as possessing a field co-extensive with the universe itself, its gravitational field. It has also its energy field, perhaps comprising the magnetic field due to motion of electrons, and the electro-static fields between the oppositely electrified or positive and negative electrons.

In the ordinary case of transmission by low-frequency currents, such as 50 or 60 cycles rate, the losses do not include radiation of energy into the space surrounding the lines, as such loss is entirely negligible. At high frequencies, however, the loss by radiation rises to a measurable quantity, and at the highest frequencies practically all of the energy may, according to the disposition of the apparatus, be radiated. In such a case as in wireless transmission, no return conductor exists or is needed. In the past few years the advances made in this form of electric transmission have been very great, and have given rise to a new art of unprecedented importance to the future. These recent advances have depended upon the more accurate tuning of the receiving apparatus to the pitch or frequency of the waves sent out, as well as upon the purifying or sharpening of that frequency itself. But, more important still, for the long-distance transmissions, has been the introduction of the principle of amplification, a truly great achievement, whereby energy is added progressively to the feeblest received impulses, so that at last they not only may affect the simple ear phones adequately for "listening in," as it is termed, but may even be so magnified or enhanced as to produce loud tones from a receiver provided with an acoustic horn, such sounds as can, in fact, be heard over a large hall. This seeming miracle has been brought about by development, in the hands of Professor Fleming, De Forest and many others, chiefly in the research laboratories of such organisations as the Western Electric and General Electric Companies in America.

MAGNETIC METALS.

Constant study in the past years has steadily reduced the losses of power by eddy currents and hysteresis, so that in comparison with former periods, these losses are relatively very small, and represent but a small percentage of the total output of the machinery. Still the end is not yet, and there are indications that further improvements are to be expected in the near future, if the serious factor of too great cost does not control. It would seem, indeed, that no definite limit can yet be set to the attainable reduction of iron losses, except it be the cost of production of the higher or better qualities of iron or steel used as the magnetic media. The exceedingly valuable study of Professor Ewing in the field of magnetism of iron, nickel, cobalt, and alloys is still authoritative. (It may be recalled that the James Forrest Lecture on Magnetism was given by Professor Ewing in 1899.) The search for iron of lower and lower hysteretic loss goes along with the study of the causes of that loss. The recently discovered "Perm-Alloy," which magnetically saturates even in the earth's field alone, points the way to improvements in instruments based on magnetic effects, and raises questions as to the possible discovery of other alloys with equally surprising magnetic qualities. Then there are the new cobalt iron steels, recently studied by Honda, which, for the construction of permanent magnets—important for many structures now in use in electrical work—mark out a new path for the designer. It is not to be expected that any real substitute for copper as a conductor of electric currents can be found, certainly so far as dynamo machine construction is concerned.

INSULATION.

It may, perhaps, be truly said that in the matter of insulation in electric machinery or structures, there will always remain room for further advances. The ideal in this respect can be set as high as one pleases with little hope of attainment. It should be non-puncturable, undestroyed by temperature elevation, should not allow current to be conducted as by leakage, should be moisture-proof, should conduct heat, and should retain these characters permanently. In reality, the insulation is usually the perishable thing, and may break down from overheating or puncture by surges raising the potential differences, and other causes. Evidently, the case is one for continual improvement, but always within a limited compass. In passing, may be mentioned the more general use than formerly of filled insulation in electric apparatus, a practice which will undoubtedly become universal in important structures. The object is to remove all vacant spaces or porosity in insulation by a solid filling of insulating material, usually applied hot and liquid to a coil or wound structure, and then cooled and solidified.

LARGE GENERATORS.

The largest dynamo yet constructed is probably the one recently built for use at Niagara Falls, which has a rated capacity of 65,000 kilowatts, easily capable of carrying with but slight overloading considerably more than 100,000 horse-power. Years ago the wisdom of constructing large units was debatable, as a breakdown with the removal of any very large unit was naturally more serious. It is an indication of general advance in construction and safeguarding that designers are willing to consider such large units. How far it is legitimate to go in such direction may be considered a still unsolved problem. Turbo-generators with their high speeds, notwithstanding the care given to their development during the past twenty-five years or more, present difficulties not so much electrical as mechanical in nature. The real questions which arise are those of mechanical engineering, balance, vibration, critical speeds, effects of varying torque, centrifugal deformation, &c.

ELECTRICITY AND MARINE PROPULSION.

A recent well-known application is the use of turbo-generators in what is termed the electric drive in ships—even battelships of the most powerful type having been lately so equipped. The power is generated in the form of electric current energy from the several turbo units at governed or constant speed, and delivered to huge electric motors on the screw shafts in the form of polyphase current, the control and manipulation of which is obtained by a system of switch combinations, in turn remotely controlled by the officer in charge, by relays or contactors, as in railway work.

INTERNAL COMBUSTION ENGINES.

For a considerable number of years past, internal combustion engines, chiefly of the Diesel type or modifications thereof, have been put into more and more extended use for power generation from fuel oils. The use of these engines for driving ships does not especially concern us here, but recently such oil engines have begun to be adapted to the "electric drive" for ships, in the same sense that steam turbines have been applied. History is certainly in the making in this oil engine electric drive.

Having made allusion in the above to the electric drive for ships, it is proper to mention "gasoline (petrol) electrics," in which, instead of the direct application of the power of the internal combustion engine, as is usual in automobiles, there is employed an electric intermediary, sometimes in the form of a dynamo driven by the engine at approximately constant speed, coupled by electric conductors and switch control, to electric motors geared to the vehicle axles for driving them with varying speed and torque. I am not aware, however, that these particular forms of vehicle electric drive have been in extensive use. There is, however, an indication that such a plant may find useful application on a considerable scale, as in the recent production in America of a locomotive, embodying in its make up a solid injection jet multi-cylinder Diesel type oil engine, and direct connected dynamo generator, the current from which is delivered under control to motors geared to the driving wheel shafts of the locomotive itself.

RAILWAY ELECTRIFICATION.

An account of electrical engineering progress and possibilities would not be complete without reference, at least briefly, to the application of electricity to railways—railway electrification. Over thirty years ago electricity began to be applied extensively to traction on street railways or tramway lines, the city of Boston, Mass., being the first large city to adopt the plan for all its lines. This was in 1889. For years thereafter there was a continued great extension in this field, gradually including, in addition, suburban and inter-urban lines, the latter often many miles in length. When it came to the electrification of parts of trunk lines, differences of opinion arose as to the question of the employment of direct current or alternating current in the operation of the motors. At the present time this is a question which can hardly be said to have been settled, the circumstances of railway work varying widely.

It is not intended to discuss here the various arguments presented, but merely to present, as briefly as possible, the two chief sides of the argument. It may be conceded that direct-current motors are, on the whole, preferable to alternating-current motors of any type, which latter can only approach direct-current characteristics when the frequency is low—15 or 16 cycles. As for general uses the machinery for generation and distribution of alternating currents is based on the use of 50 to 60 cycles, a decided disadvantage exists in alternating-current driving. While it is possible to use "frequency changers"—a type of rotating machine—for lowering the frequency, the added cost of plant is usually prohibitive. An advantage, however, possessed by alternating-current operation is that the voltage of the motors may be chosen as desired, by the use of transformers on the locomotive, while with direct current no such possibility exists, and the voltage of the motors must be chosen to match the supply from the line by the pantograph collector. There is, however, a certain flexibility in this case, since the motors may be operated at 1500 volts—found to be a safe voltage for a railway motor with direct current—and these can be coupled in series in pairs, so that a line pressure of as high as 3000 volts may be used. The alternating current has the advantage of high-efficiency transmission at high voltages over long distances, which can only be secured when the motors are of the direct-current type by the use of rotary converters, for generating direct current from the transformed alternating system, or by using a high-power rectifier of the mercury-arc type for the same purpose.

LOCOMOTIVE CONTROL.

In such heavy railway work the control apparatus in the locomotive cab is most important. Many years ago several methods of multiple-unit control were put into service. They were alike applicable to locomotive control where several motor units are concerned. I happened to devise for such purposes the form now known as "contactor" control, and it is a satisfaction to find that it has survived and with added developments has become practically universal. It appears to have proved itself the best means for securing equal control of several motor units by a master controller conveniently placed.

AUTOMATIC SUB-STATIONS.

Beginning several years ago and growing to a considerable importance in electric distribution is the practice of establishing completely automatic sub-stations. Automatic control of generating stations and of sub-stations even for lighting where the voltage has to be controlled from a distance, is a recent notable achievement. It is indeed a safe prediction for the future that the "tying in" of many such remotely, or automatically, controlled stations upon common transmission lines for supply and distribution of electric energy will be a characteristic more and more in evidence.

POWER FACTOR CORRECTION.

The problem of providing means for adjusting or correcting the power factor of an electric system of distribution and supply is only existent in alternating-current work. Any lack of coincidence of the current wave forms and their maxima and minima with the potential wave forms, including zeros and maxima, indicates a power factor less than the ideal of 100 per cent. In alternating-current systems the current wave is often considerably lagged, or is behind in time with respect to the potential wave. To correct this condition, which may become serious, by its loading the system—generators, lines, transformers, &c.—with idle current which flows but does no useful work, devices known as synchronous condensers are employed. The idle current on the line, though doing no work, nevertheless involves a loss of power in

* Institution of Civil Engineers. The James Forrest Lecture, July 8th, 1924. Abstract.

resistance, wherever that may be, so that, while it diminishes the capability of the whole plant by uselessly loading the conductors, it increases the losses therein. The synchronous condenser is usually an unloaded motor whose speed, as its name implies, is synchronous with the frequency of the system. It is so constructed and proportioned magnetically that it furnishes what is known as a leading current—the opposite of the objectionable lagging or idle current, and obliterates the latter—leaving the work current wave in phase with the potential wave.

STATIC CONDENSERS.

Perhaps the most difficult of the problems with which the electrical engineer has to deal is the construction of reliable static condensers so called, the prototype of which is the Leyden jar. The word "static" in this connection is not intended as an electrical term, but merely that it is stationary, without moving parts. Constructed of metal foil separated by layers of insulating material which must be thin to insure a charging or capacity of practical value at small expense, and which insulation, though thin, must resist puncture or breakdown indefinitely, even when the applied potential is accidentally increased by surges, the static condenser is indeed an outstanding problem. At the same time, it must not be so expensive to construct and maintain as to cancel the advantages of its use. To obtain the needed current capacity the metal foil surfaces must be very large, while any slight defect in the insulating layer between them anywhere over the very extended surface almost surely means a breakdown sooner or later. Such a breakdown is at once followed by a heavy current discharge—a short circuit of the total charged surface of large extent.

The weak points, unfortunately, are not evident except under prolonged use; a slight fault or leak in the dielectric layer leads eventually, under constant stress, to final breakdown.

A procedure, which is, in fact, not a solution, is to build such condensers in sections of limited capacity, each section provided with fuses or cut-offs, so that sections showing faults may be easily removed and replaced, while the fittest may thereafter survive for a time more or less prolonged. Even with existing imperfections, some use has been made of static condensers in improving the power factors in local distribution, but it must be said that condenser construction and use still present unsolved problems. What progress is to be made in the years to come must be gradual, unless there be substituted some better type of construction as yet unfound.

ELECTRICITY AND HEAT PRODUCTION.

In the application of electricity for the production of heat, we may note two phases. One of these is the substitution of electric heating for the ordinary heat of combustion, and the other is the securing of such conditions of heating and high temperatures as are unattainable in combustion furnaces.

In passing current through a resistance, heat is developed at 100 per cent. efficiency. It has not been found, however, except in special instances of cheap water power for driving the generating plant, that electric energy can be economically applied to the warming of buildings or rooms, in substitution for other ways of heating, as by combustion heat, however applied; although for many years in the severe winter climate of North America the warming of tramcars has been accomplished by electric heat generated by passing current from the overhead wire —trolley wire—through resistance boxes in the cars, a method sometimes used in railway trains. On account of the fact that even in the best power development plants, excepting water power, the efficiencies of heat conversion are still relatively low, delivered electric energy is costly when converted into heat. Scarcely 15 per cent. of the heat value of fuel is returned as electric heat. It is not surprising, therefore, that the applications of electric heating so far are for special purposes.

ELECTRIC WELDING.

In the art of electric welding two important departures have been made in recent years. One is the use of what is known as the "flash weld," and the other is the modification applied, instead of riveting, to sheet metal, and known as "spot welding." In the flash weld, instead of the metal pieces to be united being brought together firmly or with considerable pressure before passing the welding current through the joint, they are but lightly contacted at the start, so that the resistance at the joint is high, the condition being that of partial contact only. The energy applied is thus at first used in a very local heating at the meeting faces, and in the case of a wide plate the prominent parts of an irregular contact edge are burned off so that the pieces become automatically fitted to each other before union. Under this local heating the weld is finally completed by quick heavy pressure forcing them together, which causes extrusion of the very much softened or fused metal out from the joint as a thin fin, easily removed. All resistance welding is naturally benefited by sharp localisation of the heating effect to those portions or faces of the metal pieces to be welded. I may here mention one of the curiosities of the art, at first seemingly anomalous. It is the welding of copper with decided benefit under a stream of water directed on the weld during the heating and formation of the joint.

In the past ten or fifteen years that form of electric resistance welding called spot welding has attained very great importance, having widely extended use in metal constructions, chiefly of sheet steel. Its application began with the uniting of parts of thin steel afterwards to be enamelled, as in the great variety of culinary vessels known as enamelled ware. It replaced riveting, which gave rise to difficulty in enamelling owing to the projecting rivet heads, which were also sensitive to flaking of enamel from mechanical shocks or blows. A considerable percentage of "seconds," so called, or imperfect ware resulted from use of the riveting method of union of parts. The spot weld, however, gave a smooth surface and required no preparatory punching or drilling of holes for rivets. Simply placing one sheet metal piece over the other between two electrodes with blunt ends with pressure and the passage between the opposed electrodes of a heavy welding current sufficed for securing union between the pieces. It is worthy of note here that, although the term "electric welding" was first applied to my invention of resistance welding nearly forty years ago, in which very large currents at voltages of only 1 volt to 4 volts were concerned, and although it was known since 1880 or before, that an electric arc might be used as a sort of blow-pipe to fuse and deposit metal to form a joint, it has only been in the past ten or fifteen years that this fusion process by the arc has taken on any great importance in the art of joining metal structures. Though not strictly a welding process, this arc fusion is now known as arc welding, and the operatives who have acquired skill in the work are known as electric welders. It has been found that for certain forms of standard work, as in fusing seams in tanks, arc-welding machines have been developed, thus relieving the operator of some of the discomforts of his work. It is possible that automatic machines will in the future find more and more extended application, especially in standard production or repetition work. Alternating-current arcs have not the same applicability to electric arc welding as direct-current arcs. The low-frequency arc is liable to become extinguished at the zeros of current. Recently an ingenious proposal to combine with the low frequency a superposed wave of much higher frequency has been made, it being well known that even with alternating current, arcs at, say, 1000 cycles per second or over differ little in persistency or continuity from those obtained by the direct current commonly used.

ELECTRIC FURNACES.

There is here no time or space to refer at any length to the use of electric heating in cooking or in electric furnace work. The arc furnaces used in steel melting and treatment, or the types of resistance and induction furnaces are now in somewhat extended use for many and varied purposes and are well known. There is an induction furnace—the Northrup high-frequency electric furnace—which is a later development. In this case, there is no ring hearth or circuit surrounding a laminated iron core, as in the common forms of induction or transformer furnace, but merely a crucible of usual shape, in which the metal to be melted and treated is placed. Surrounding the crucible is a jacket of heat non-conductor of refractory material, and outside of and surrounding this latter is a current-carrying coil or winding made of a copper tube, through which during operation water is circulated for cooling.

ELECTRIC LIGHTING.

The beginnings of what we sometimes refer to as heavy electrical engineering came with the desire to use electricity for lighting, of which at least two forms have gone into most extended use—the arc and incandescent or glow types. The carbon arc held its own with modifications from open to enclosed and impregnated carbon arcs until about twenty years ago, when it began to be replaced in large measure by the type called the luminous flame arc, in which the flame of the arc itself emits the light, and not the heated solid ends of the electrodes, as formerly. The intermediate step was, of course, the use of carbons impregnated with mineral constituents, where both solid and gaseous emission were concerned. At present, while there still remain installations employing carbon arcs as originally used, street illumination, especially in America, most frequently involves the use of metallic arcs, termed magnetite arcs, from the chief constituent of at least one electrode being magnetic oxide of iron.

Turning now to the incandescent or glow lamp, we come to a chapter of electrical research and engineering, which has commanded attention as an important factor since about 1880. In spite of efforts made through a long series of years to supplant the original carbon-filament lamp, it was nearly three decades before much progress was made. The osmium filament came, but there was not enough osmium to be found in the world to make the required filaments. This was followed by the tantalum lamp, which, though like the osmium lamp, more economical of energy for a given output of light than the best forms of the carbon-filament lamps, was only a step forward, and it did not really satisfy the conditions of a decided advance. When, however, attention was turned to the metal tungsten, known in older times to the chemist as a dark infusible powder, it was soon found that it would bear a very high temperature in a good vacuum without melting or volatilising. Its properties as a metal—hard, brittle, unworkable—constituted obstacles difficult to overcome. The question then became, "Could a sufficiently strong filament, mechanically considered, be produced from tungsten?" After much research, the problem was at last solved by Dr. W. D. Coolidge, in the production, by a special process, of a tough wire of tungsten; a metal known before as hard, brittle, unworkable. With such a wire as provided by the Coolidge methods, it was only necessary to use in a lamp a definite length and diameter of wire to obtain standard lamps of voltage desired, where before there was in their production a wide and unavoidable variation.

STORAGE BATTERIES.

A review of this kind, incomplete as it must necessarily be, especially concerning many electric applications, such as in telephony and forms of wire and cable communication, may include a short statement in regard to storage by accumulators or storage batteries. Practically there are but two types of such batteries extant, the lead couple in sulphuric acid, and the iron-nickel couple in caustic alkali—the Edison battery. The largest examples of the former type are to be found in the great direct-current stations in cities, some of which are equipped with battery storage of sufficient amount to carry the Sunday load, which on that day is mostly a light load. Outside of stations, the lead battery has found a widespread use in recent years in the lighting of automobiles, and especially the starting of the engines, as in former years it also found application in starting gas or oil engines in isolated or house plants. None the less, the lead storage battery is still possessed of serious disadvantages and disabilities. It wears out in use; it is heavy. If discharged even partially and left to stand, the active material of the plates becomes non-conducting sulphate of lead, and, to all intents, the battery is lost or dead. If allowed to stand charged, its insulation is generally so poor that the charge leaks away, corroding the parts. No more than in the lead battery is the ideal of storage found in the iron-nickel alkaline cell developed about 20 years ago by Edison, and known as the Edison storage battery. This type of battery possesses elements of permanence not found in any lead cell. Its insulation is so good that it may maintain a charge for years. It is not destroyed by over discharge. Unfortunately, its voltage is very variable on discharge, its efficiency much less than the lead cell, and its internal resistance so much higher, that it cannot supplant the lead cell in starting automobile engines. Another disadvantage of the Edison cell is its increased internal resistance at low temperatures. Evidently this type of cell, useful as it may be, does not provide a true solution of the storage problem. Perhaps there is no solution possible.

CONCLUSION.

In the foregoing necessarily brief outline of the present and possible future of electricity and engineering based on electric principles, nothing has been said of many other branches of the work, the ramifications of which are endless. In all of them the importance of measuring and standards of measurement as well as instruments for measurement is well understood. Lord Kelvin himself made many notable contributions in instruments, which became of great value, and which have lost little of applicability in more recent years. In no art has exact measurement more importance than in the electrical field, and instruments of all degrees of refinement are now at hand for service. Often, as in the measurement of high temperatures in pyrometry, the actual readings are made by electrical instruments.

Who is there to tell us of the momentous issues and events which may arise out of the studies in pure science, of atomic and molecular structure, and the energy relations involved, which has become in large measure the chief study in physical science of our day? Perhaps our comparatively feeble beginnings in thermionic emission and the manipulation, so to speak, of electric ions, infinitesimally small though they be, coupled with the knowledge of the electric structure of matter in all its forms, may be the foundation of a greater or super-science of electricity of enormous importance to the future achievements.

May we not hope through such work to reach the solution of many problems, as, for example, the direct production of electric current energy from the rays of the sun, by some form of absorbing ionic vacuum apparatus, and thus add greatly to the habitable areas of the world?

THE report for 1923 by Dr. L. A. Bauer, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, summarises briefly a long record of notable work at home and in the field. The magnetic survey yacht Carnegie was not in commission during the year. The final computation of the magnetic results of its cruises from 1915 to 1921 is now completed. Field work was devoted chiefly to the determination of secular and diurnal changes. Except in a few stations in Haiti and the Dominican Republic and those on expeditions to the Xingu and Trombetas tributaries of the Amazon, all the stations occupied had been used for previous observations. In carrying out this work, the observers of the Institution have travelled far afield in North and South America, Malaya, certain Pacific Islands, and as far north as Etah in Greenland. The report concludes with a series of useful abstracts of published papers.

High Voltage Electricity Transmission.

A PAPER entitled "High Voltage Direct-current Generation and Distribution of Electrical Energy" was presented at the World Power Conference by Messrs. J. S. and W. E. Highfield. From this paper we give some abstracts below.

The authors deal with the advantages of direct-current transmission from the point of view of lines and cables and describe the transverter which has been invented by Messrs. W. E. Highfield and J. E. Calverley.

They put forward figures of cost of lines, at present prices in this country, first, for 100 miles straight transmission, and, secondly, for 50 miles. It is assumed that the whole of the load is concentrated at the extreme end of the line as it would be if power were carried to a great industrial centre from a distant power station. The first example is a line 100 miles long where the conditions permit of overhead transmission. The alternating current line is designed for 3-phase alternating current at 150,000 volts with a double circuit, or six wires, to deliver 50,000 kilowatts at ·8 power factor. The line is carried on galvanised steel towers with 800ft. spacing. The conductors are steel core aluminium stranded cable with a conductivity equal to copper conductors of ·15 square inch section. The earth wire is $\frac{7}{8}$ S.W.G. galvanised steel.

The cost of the complete line is £250,000, or £2500 per mile. The line would, at 50 cycles, give a regulation of about 10 per cent. and adrop in pressure of 8 per cent.

To compare with this line, the authors consider the cost of a line for carrying direct current, consisting of two steel core aluminium stranded conductors each having a conductivity equal to .25 square inch of copper and insulated to withstand 200,000 volts to earth. The line is carried on steel poles 800ft. spacing with similar insulators to the 150,000-volt alternate current line. A diagram showing the poles and insulators is shown in

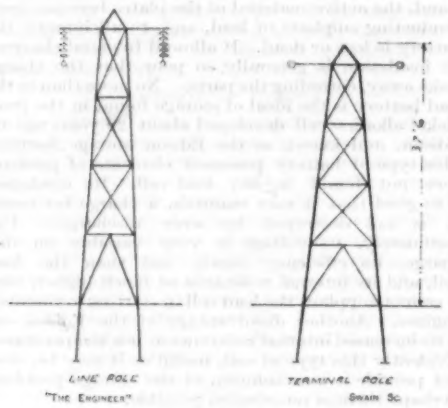


FIG. 1

Fig. 1. If line is used as a two-wire line with both poles insulated, its capacity is 50,000 kilowatts.

The cost of the complete line is £165,000 for 100 miles, or £1650 per mile. This line may, however, be used in a different manner. The two wires may be used as positive conductors in parallel, the earth being used as a return. This method increases the maximum capacity of the line to 100,000 kilowatts, or a safe capacity, with reserve, of 60,000 kilowatts with a spare line from end to end in emergency. The pressure drop at 50,000 kilowatts, using the two lines as insulated lines, is 4.4 per cent.

The pressure drop at 60,000 kilowatts using the two lines as positive conductors in parallel, the earth being used as the return conductor, is 1.32 per cent.

The comparative figures, therefore, are as follows:—

For the alternating current line, the capital cost works out at £5 per kilowatt per 100 miles.

For the direct-current line, using two conductors insulated, with earth circuit treated as standby, is £3 3s. per kilowatt per 100 miles.

For the direct-current line, using the two conductors, in parallel, the earth being used as the return conductor, this line having a useful capacity of at least 60,000 kilowatts, even if one line were disabled, is £2.75 per kilowatt per 100 miles.

The authors give the following comparisons of cost of line work for a distance of 50 miles:—

The alternating current line is designed to work at a pressure of 66,000 volts 3-phase and to deliver 20,000 kilowatts at a power factor of .8. The line consists of two circuits each of three conductors having a section equal to .2 square inch of copper. The line is carried on steel towers and is provided with $\frac{7}{8}$ gauge galvanised steel earth wire. The prices are for steel core aluminium stranded conductors. The total cost of the above line is £148,000.

A comparable line for carrying direct-current should work at 100,000 volts pressure to earth. The line consists of two conductors, each having a section equal to 0.1 square inch of copper, both lines being insulated for the full pressure to earth, and the insulators being of exactly the same type as those used on the 66,000-volt alternate current line. The line is carried on steel towers and is provided with $\frac{7}{8}$ gauge galvanised steel wire. The total cost of this line is £61,000.

This line, with the two conductors working in parallel, would easily carry a maximum power of 20,000 kilowatts and approximately 12,000 kilowatts with one line out of action. It, therefore, has exactly the same capacity as the alternating current line above.

A similar line but with two conductors, each having a section equal to 0.2 square inch of copper, would cost £74,500. This line would carry the 20,000 kilowatts using a complete copper circuit and the earth as a standby conductor, or, with both conductors working in parallel, each conductor would carry 20,000 kilowatts, so that the useful capacity might be taken, in these circumstances, as at least 25,000 kilowatts.

The comparative figures for the three lines work out as follows:—

(*a*) The alternating current line, taking the capacity at 20,000 kilowatts, which it will have only when both lines are intact, would cost £7.4 per kilowatt per 50 mile run.

(*b*) The first direct-current line, taking the capacity at 20,000 kilowatts, so as to be strictly comparable with the alternate current line, would cost £3.05 per kilowatt per 50 mile run.

(*c*) The second direct-current line, taking the capacity at 20,000 kilowatts with both poles insulated, would cost £3.725 per kilowatt per 50 mile, or at 40,000 kilowatts, using an earth return, £1.8625 per kilowatt per 50 mile.

For a distance of 100 miles, the authors contend, it is probably commercially impracticable to carry alternating current in underground cables, but they have worked out the cost of carrying direct current a distance of 100 miles with cables worked at a pressure of 100,000 volts to earth, which is a perfectly practicable cable.

The line consists of two single core cables, a section of which is shown in Fig. 2, having conductors of .3 square

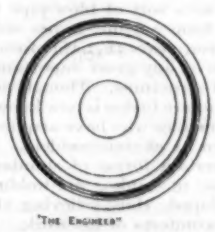


FIG. 2—0.3 sq. in. single core 100,000 volt. direct current to earth

FIG. 3—0.125 sq. in. single core 100,000 volt. direct current to earth

inch section of copper. There are 1400 joints in the 100 miles run. The cable is laid in the ground with protecting covering boards. It is assumed that 90 miles of the distance is in country districts and 10 miles under macadam. The total estimated cost of the whole cable system is £306,000. This line, as in the case of the overhead lines may be worked either by using the completely insulated system and treating the earth connections as a standby or the two cables may be used in parallel using the earth as the return conductor. In the first case, the capacity of the line would be, at least, 20,000 kilowatts, with a pressure drop of 5.68 per cent. In the second case, the maximum capacity of the line would be 40,000 kilowatts, and the useful capacity, assuming that one cable be broken down, would be 25,000 kilowatts.

The cost works out, under the first estimation, at £15.3 per kilowatt for the 100 miles run, or at £12.24 kilowatt at its useful capacity of 25,000 kilowatts.

The authors submit further comparative figures for underground cable transmission systems for a straight distance of 50 miles:—

The first example consists of a line comprising two three-core cables, each with copper conductors having a core of .15 square inch, a section of which is shown in Fig. 4. The two cables working at a pressure of 50,000 volts would carry a load of 20,000 kilowatts. Eight

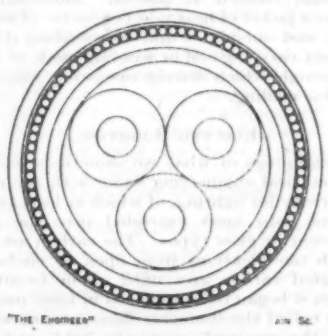


FIG. 4—0.15 sq. in., 66,000 volt star three-core three-phase alternating current.

hundred joints are allowed for in the 50 miles run. The cables are laid in the ground with protecting covering boards. The total cost of this line is £278,000.

A similar line, but consisting of two cables having three conductors, each of .3 square inch copper section, and working at a pressure of 33,000 volts, would cost £340,000.

Contrasted with the above two examples, a direct-current system consisting of two single-core cables, a section of which is shown in Fig. 3, each having a copper section of .125 square inch and laid in the ground with protecting covering boards, would cost £128,000, and a similar line with two single-core cables, each having a copper section of .25 square inch, would cost £153,000.

The comparative figures work out as follows:—

The alternating-current line can carry a maximum load of 20,000 kilowatts at .8 power factor, with a drop in pressure of 15 per cent. At this capacity, the cost of the 50 mile run is £13.9 per kilowatt. Allowing for the useful capacity of this line as 12,500 kilowatts, the cost works out at £22.24 per kilowatt.

The second alternating-current ilne, consisting of two cables, each having conductors of .3 square inch section, can carry a maximum load of 20,000 kilowatts at .8 power factor, with a drop in pressure of 17 per cent. At this capacity the cost of the 50 mile run is £17 per kilowatt.

The comparative direct-current line, consisting of two single-core cables each of .125 square inch, and using the earth as the return conductor, will have a capacity of at least 20,000 kilowatts, would cost £6.4 per kilowatt, and with two single-core cables, each of .25 square inch section, and using a completely metallic circuit, will have a capacity of at least 20,000 kilowatts, and will cost £7.65 per kilowatt for the 50 mile run.

The above figures, of course, relate only to the cable system.

THE QUARTER'S SHIPBUILDING RETURNS.

LLOYD'S Register shipbuilding returns for the quarter ended June 30th show that the tonnage under construction in Great Britain and Ireland—1,516,746 tons—was about 43,000 tons more than at the end of March this year, and showed an increase as compared with twelve months ago of about 179,000 tons. The present total, however, includes 52,000 tons on which work is suspended. Deducting this tonnage in order to enable a comparison to be made with figures for normal times, it is seen that the tonnage actually under construction at the end of June amounted to about 1,465,000 tons, which figure is the highest reached since the end of March, 1922. The average tonnage being built during the twelve months immediately preceding the war was 1,890,000 tons, *i.e.*, 425,000 tons more than the present total. A considerable increase is shown in the tonnage commenced during the quarter, namely, 375,210 tons, as compared with 227,786 tons during the first quarter of 1924. The tonnage launched during the quarter—364,518 tons—is the highest reached during the last 2½ years. The tonnage of motor ships being built at the end of June reached 355,590 tons, equal to nearly 31 per cent. of the steam tonnage under construction.

The total merchant tonnage being built in other countries—1,100,151 tons—includes about 140,000 tons upon which work has been suspended, leaving about 960,000 tons actually under construction; the latter figure is 35,000 tons more than at the end of March, 1924. The figures for the leading countries abroad are:—Germany and Danzig, 340,749 tons; France, 144,240 tons; Italy, 127,772 tons; United States, 103,665 tons; and Holland, 96,453 tons.

From a table showing the number and tonnage of vessels launched and of vessels commenced in the world during the quarter under review, it is seen that 243,974 tons were launched abroad and 163,666 tons were commenced, an increase of 40,154 tons in the tonnage commenced, but a decrease of 25,072 tons in the tonnage launched. The total world tonnage shown—2,616,897 tons—includes 192,000 tons on which work is suspended. The tonnage actually under construction is thus 2,425,000 tons, which total is 1,022,000 tons below the highest pre-war record reached on June 30th, 1913, viz., 3,446,558 tons.

There are at the present under construction in the world 35 vessels of between 10,000 and 20,000 tons each and 8 of 20,000 tons and upwards. Twenty-one out of the 35, and all the larger vessels, are being built in Great Britain and Ireland. The returns show that there are at the present time 28 steamers and motor ships, each of over 1000 tons, with a total tonnage of 180,170 tons, under construction in the world for the carriage of oil in bulk. Of these tankers, 13 of 87,570 tons are under construction in Great Britain and Ireland.

The tonnage of vessels now being built in the world which are to be fitted with internal combustion engines amounts to 810,655 tons, while the tonnage of steam vessels under construction is 1,785,480 tons. The motor tonnage thus equals nearly 45½ per cent. of the steam tonnage. Of the total tonnage being built in Germany nearly 60 per cent. consists of motor ships. The total figures include 69 motor ships each of between 5000 and 10,000 tons; 5 of between 10,000 and 15,000 tons; and 7 of between 15,000 and 22,000 tons.

INSTITUTION OF ELECTRICAL ENGINEERS

A SUMMER tour has been arranged for the London Students' Section of the Institution of Electrical Engineers. The programme has been drawn up in consultation with the Société Française des Electriciens, and two prominent officials of that Society have travelled to England especially to confer with the students committee. The following itinerary has been arranged:—First day, Saturday, August 2nd, depart London (Victoria) 10 a.m. and depart Paris 10.25 p.m.; second day, Sunday, arrive Lyons 7.30 a.m. Afternoon, visit to Poleymieux Vineyard; third day, Monday, morning, visit to inspect the "Thury" direct-current transmission system; afternoon, visit to the Central Station de la Mouche—70,000 volts; fourth day, Tuesday, morning, visit to the Berliet Motor Car Works; afternoon, visit to a silk factory; fifth day, Wednesday, pleasure trip around Lyons; sixth day, Thursday, morning, visit to a coal mine at St. Etiennes; afternoon, visit to the 120,000 volt station of the Power Company de la Loire et du Centre; seventh day, Friday, visit to the Lyons Radio Station; eighth day, Saturday, depart for Paris 10 p.m.; ninth day; Sunday, August 10th, arrive Paris (Lyons) 7.25 a.m.; arrive London (Victoria) 6.40 p.m.

CANADA exported to the United States 30 per cent. more electric power during the year ending March 31st than she did during the preceding year, the quantity being 1,400,231,340 kw.-hours, as compared with 1,054,872,000. About 60 per cent. of this was through the Niagara Peninsula. Another 30 per cent. was from the Cedars Rapids development on the St. Lawrence River. Another much smaller block went from the Rainy River district in north western Ontario, while from British Columbia a small amount trickled over the boundary line. The use of hydro-electric power by Canadian industries is proceeding much faster in Canada than it is in the United States. Since 1902 the increase in the use of such power for industrial purposes in the United States has been fourfold, but in Canada it has been eightfold.

A New Rack Locomotive.

A NEW development of the rack system of railway traction which is specially intended to enable comparatively light permanent way to be used over hilly country, has recently been brought to a practical stage by the Railgrip Syndicate, Limited, of 2, Gresham-buildings, Basinghall-street, London, E.C. 2, and some trials which we witnessed at the works of Beguely, Limited, Burton-on-Trent, suggest that the system should greatly extend the field of usefulness of light railways.

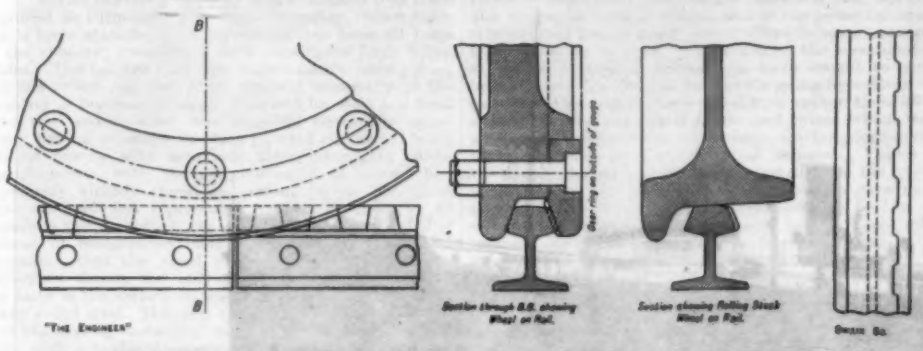


FIG. 1—ARRANGEMENT OF NOTCHED RAILS AND TOOTHED FLANGES FOR "RAILGRIP" TRACTION

Briefly the idea is to provide a steam locomotive with an auxiliary pair of cylinders, and to use them to drive a pair of wheels, having a positive grip on the rails, through a set of speed reducing gearing. It is intended that the auxiliary engine should be brought into operation only when the gradient of the line becomes so steep that the usual driving wheels will not provide sufficient adhesion to move the load. Otherwise the engine is of quite normal design.

The merit of the system lies in the fact that the only additional weight which has to be carried, in order to surmount the gradients, is that of the two extra cylinders and their gear. The result is that the locomotive is light in comparison with a plain adhesion engine sufficiently powerful to climb the worst inclines on the line, and the permanent way can be correspondingly lightened. Also there is less deadweight to move and higher speeds can be attained on the level.

The success of the scheme depends, of course, on the ability of the boiler to supply enough steam for driving the auxiliary engine, but there is sufficient margin in the output of a locomotive boiler to supply steam to overcome most light railway gradients, and to recover again while coasting down hill. In the event of there being any exceptionally long and steep hills to negotiate, the boiler capacity could, of course, be increased.

Instead of using a separate rack rail for climbing hills the auxiliary grip is obtained on the running rails which have notches rolled on their sides—as indicated in the line drawing, Fig. 1. The notches are 1¾in. pitch and ¼in. deep, and are made on the outsides of the rails only, so that they do not interfere with the flanges of the wheels on the ordinary rolling stock. It will be noticed that the sides of the rail taper upwards—at an included angle of 42 deg.—and thus provide a very effective grip for the double-flanged auxiliary driving wheels. The outer flanges of these wheels are, of course, toothed to correspond with the notches in the rail, and are of case-hardened steel. The toothed flanges can be readily taken off for replacement. Special cast crossings and points are provided to allow the outside flange of the wheels to pass, but they can alternatively be raised clear of the rail for passing a crossing.

The cylinders for driving the auxiliary wheels are mounted above the main framing, as can be plainly seen in Fig. 2, and drive on to a crank shaft in the middle of the engine. Between the crank shaft and the driving wheels there is a set of gearing which reduces the engine speed in the ratio of 4 to 1. This gear is shown in Fig. 3. A differential gear is housed inside the centre toothed wheel, and the whole set of gearing is mounted in two frames, which slide in long horn plates in the main framing. One of the driving wheels is pressed on to the axle, while the other is a sliding fit so that it can accommodate itself to inequalities in the gauge of the rails. The teeth of the gear wheels are made extra wide to allow for this sliding movement. The bearings for the crank shaft and the axle-boxes are mounted in the sliding frames on trunnions in order to ensure the proper alignment of the gears regardless of the level of the wheels on the rails.

In ordinary running the whole of this gear is kept clear of the rails, and the engine works as an ordinary adhesion locomotive with the usual cylinders. When, however, a steep gradient is reached and the wheels tend to slip the driver admits steam to a cylinder lying across the engine, which through bell-crank levers presses down the auxiliary wheels with a force equal to about one-third the weight of the locomotive. He then opens the regulator of the auxiliary engine and supplies just enough steam to the ordinary cylinders to prevent their becoming a drag. With the advantage supplied by the 4 to 1 gearing and the positive grip on the rail, the tractive effort of the engine is naturally far greater than is possible with adhesion alone.

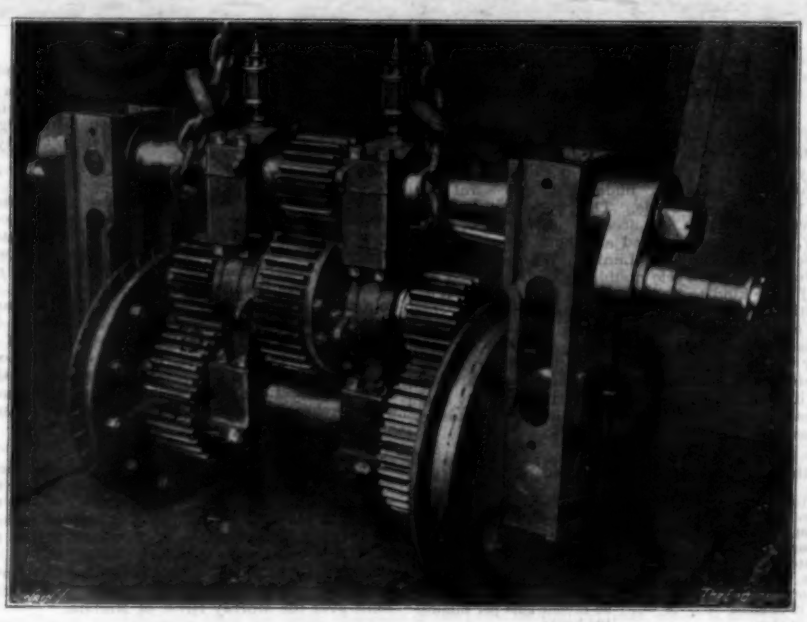


FIG. 3—AUXILIARY DRIVING GEAR FOR "RAILGRIP" TRACTION

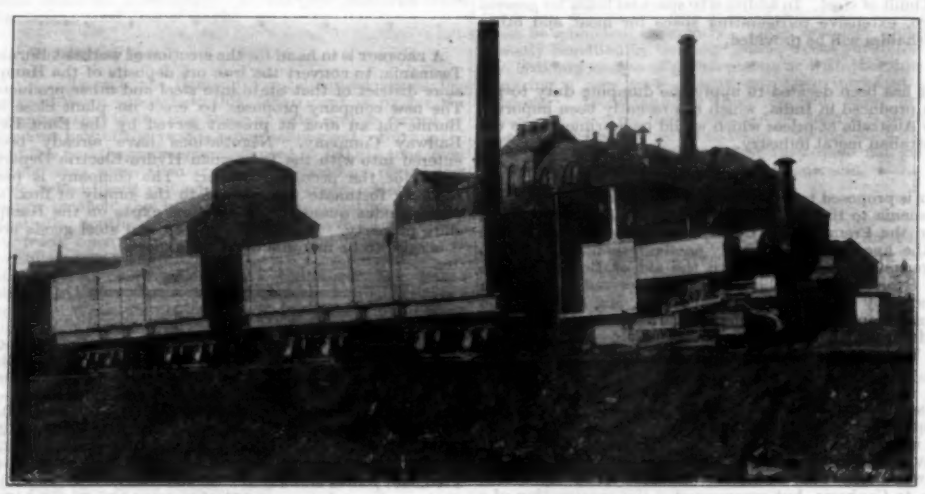


FIG. 2—"RAILGRIP" LOCOMOTIVE ON A 1 IN 12 GRADIENT

The locomotive we inspected at Burton weighs 6½ tons, or 7½ tons in running order, and is of 2ft. 6in. gauge. The boiler works at a pressure of 180 lb. per square inch, and has 118.5 square feet of heating surface, while the grate area is 3.5 square feet. All four cylinders are 6in. in diameter by 9in. stroke. The driving wheels are 20in. in diameter. With the valve gear linked up to 75 per cent. cut off the adhesion engine has a tractive effort of 2187 lb., but with the auxiliary gear at work the pull is increased to some 6500 lb.

An experimental loop of track has been laid in a field outside the Baguley works, with the sleepers on the grass unballasted, and it includes a bank having a gradient of 1 in 12, which is approached round a curve of some 75ft. radius and over a set of points. The rails weigh 25 lb. per yard. On the occasion of our visit the engine was hauling the two trucks shown in Fig. 2, which, we understand, represented a total load of 20 tons. With a running start the adhesion engine could get these trucks just about half-way up the bank, and then began to slip badly. The auxiliary engine could, however, take the load up easily. The most severe test was starting the train on the bank. With both trucks and the engine on the 1 in 12 slope and the couplings all taut, the auxiliary engine was started. The wheels jumped one or two teeth before getting a grip, but the locomotive soon got the load going. The jumping of the wheels on the notched rail did no appreciable damage to either part. The engine was equally successful in pushing the trucks up the other side of the hump backwards. In this connection it should be pointed out that the reversing gears of the two engines are interconnected so that they cannot be put in opposition.

It seems to us that there is just one point to which the inventors of the system should pay attention, and it is connected with the braking gear. A brake drum has been deliberately omitted on the auxiliary gear, as it was considered that it would be so powerful as to be actually dangerous. On the other hand, however, there is a liability for the brakes on the adhesion wheels to be deprived of part of their power, as it is possible to relieve them, to the extent of one-third of the weight, by means of the pressing down gear of the auxiliary wheels. It should be possible so to arrange matters that this conflict of purposes should not occur.

For service on lines on which there are really steep gradients, it is proposed to fit the brake vans with rail-grip wheels and brake drums, which could be brought into operation when required.

THE MOTOR SHIP BELDIS.

AT the close of last month Sir W. G. Armstrong-Whitworth and Co., Limited, completed another motor ship, the Beldis, which was built to order of the Christen Smith's Rederi, of Christiana. The following are the principal particulars of the ship :—

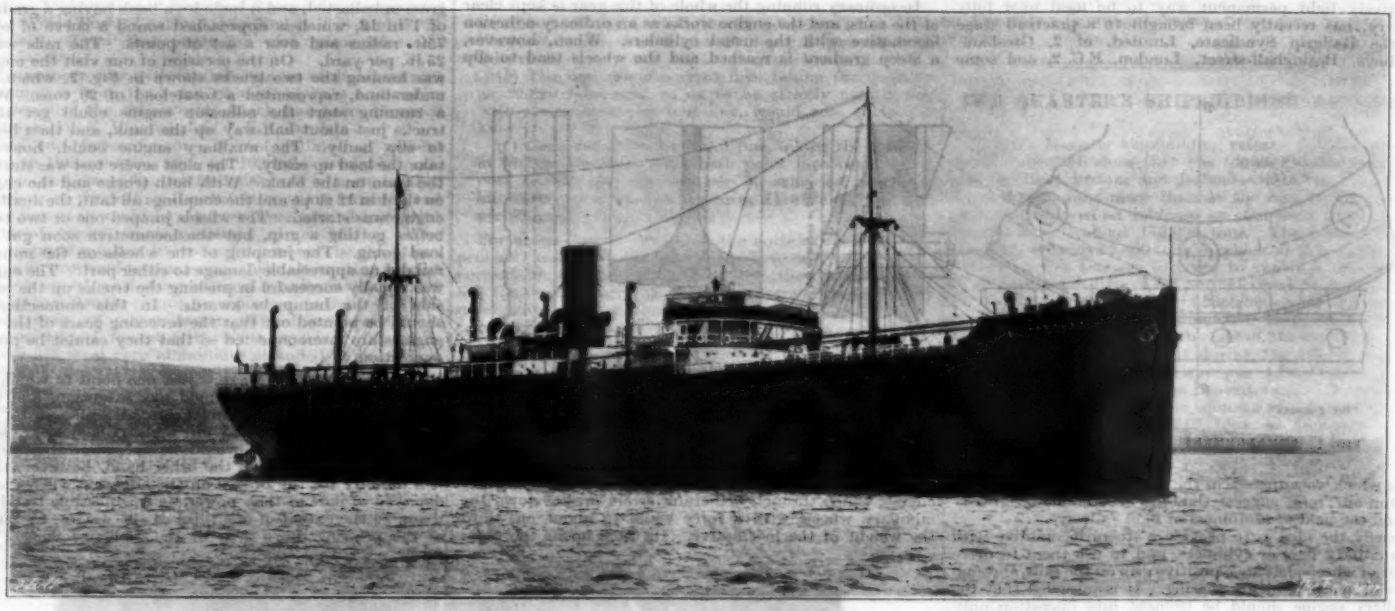
Length overall	303ft.
Breadth moulded	45ft.
Depth moulded	21ft. 6in.
Deadweight capacity	3440 tons
Loaded draught	18ft. 8½in.
Type of machinery	Armstrong-Sulzer two-cycle
Number of cylinders	Four
Diameter of cylinders	23½in.
Stroke	41½in.
Total output	1350 brake horse-power
Speed of engines	110 revolutions per minute

Both the deck and auxiliary machinery are steam driven, and steam is raised in two oil-fired donkey boilers placed in the engine-room. The vessel is unusual as regards its structure, on account of the specially large holds and the size of her hatches, which have been built for carrying locomotives, both in the holds and on deck. On her maiden voyage from Newcastle to Buenos Aires, part of the cargo of the Beldis consisted of main line locomotives, which have been built by Armstrong-Whitworth for the Buenos Aires Great Southern Railway. In accordance with the firm's recent practice these locomotives were shipped complete in running order.

THE third unit at the Cameron Falls plant of the Ontario Hydro-Electric Power Commission was started up early in June, bringing the total capacity of that plant up to 50,000 horse-power. A fourth unit is being installed.

THE MOTOR SHIP SWANLEY

BARCLAY, CURLE AND CO., LTD., AND NORTH BRITISH DIESEL ENGINE WORKS, LTD., WHITEINCH, BUILDERS AND ENGINEERS



Trials of the Motor Ship Swanley.

DURING the early part of last week the motor ship Swanley, built for Harris and Dixon, Limited, of London, by Barclay, Curle and Co., Limited, at Clydeholm Shipyard, Whiteinch, Glasgow, underwent successful sea trials on the Firth of Clyde. This vessel, it will be remembered, is notable on account of her propelling machinery, which was designed and built by the North British Diesel Engine Works, Limited, Whiteinch. The engines are of the two-cycle double-acting type, and are the first of their kind to be built in Great Britain. With one exception, namely, the Fritz, the experimental ship built and engined by Blohm and Voss, of Hamburg, the Swanley is the first vessel, we believe, to go to sea propelled by double-acting oil engine machinery. The engines referred to were described in two articles which appeared in THE ENGINEER of April 4th and May 2nd, and the leading dimensions of the ship and its machinery are as follows :—

Length overall	410ft.
Breadth	55ft. 3in.
Depth	29ft.
Gross tonnage	6200 tons
Deadweight capacity	9200 tons
Type of engine ..	Single-screw double-acting two-cycle
Number of cylinders	Three
Diameter of cylinders	24½in.
Stroke	44in.
Total output	2000 brake horse-power
Speed of engines	96 revolutions per minute
Speed of ship	10½ knots

It is satisfactory to learn that the trials of this vessel were carried out without any hitch whatsoever. Throughout the trials the engines worked, we understand, with the greatest smoothness, and there was a conspicuous absence of vibration throughout the ship. Manœuvring and reversing were carried out with rapidity and certainty, and were outstanding features of the trials. The general absence of smoke and the invisibility of the exhaust gases leaving the uptake showed that good combustion was attained.

With regard to the fuel consumption of the engines the builders inform us that the results of the trials indicate that the Swanley will be able to maintain a speed of 10½ knots on a consumption of about 8 tons of fuel oil per day, when the vessel is carrying a deadweight of over 9000 tons. An interesting feature of the installation is the comparatively short engine-room, which has been rendered possible by the application of the double-acting principle. The actual gain in the case of the Swanley is, we learn, 41,000 cubic feet over that space which would have been necessary had steam engines and boilers been fitted to the same ship. The saving is naturally more than would have been the case had single-acting oil engines been fitted. After the trials the vessel proceeded to Cardiff to load for her maiden voyage to the East.

The confidence which the owners place in this new type of engine is shown by the fact that they have recently ordered a sister ship, which will be built and engined by the same builders. A third engine of the same size and power as that mentioned in this article is also under construction in the shops of the North British Diesel Engine Works, Limited, and the firm is also constructing a four-cylinder unit of the same cylinder dimensions, which is designed for an output of 2700 brake horse-power.

Australian Engineering Notes.

THE Federal Government is proposing to spend £442,000 in providing additional telegraph and telephone cables between Sydney and Newcastle (N.S.W.) and between Newcastle and West Maitland (N.S.W.). It is proposed to put down a new cable, with 200 wires, between Sydney and Newcastle, and one containing 100 wires between Newcastle and West Maitland. Ultimately 150 telephone circuits between Sydney and Newcastle are to be provided. The revenue derived from the lines between Sydney and Newcastle is at present £20,000, which figure, it is estimated, will be increased to £120,000 in twenty years.

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PROPOSALS for the standardisation of electrical power projects in the Commonwealth have been considered by a conference of representatives of the States, which met recently in Melbourne. The conference was called by the Federal Treasurer as the result of a resolution passed at the Premiers' Conference last year. At that conference it was decided to appoint a committee of experts of the Commonwealth and States to determine the immediate and prospective power needs of Australia for the next twenty years, to make an inventory of the resources of fuel and water power available for the supply of the demand expected, and to prepare on general lines a comprehensive power plan for the whole of Australia.

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THE New South Wales Public Works Department is calling for tenders, closing on September 1st, for the manufacture, supply and delivery at Melbourne of the metal work for one steel lift-span of 60ft., four steel truss-spans of 121ft. 5½in. each, and steel superstructure for eleven approach spans, nine of which are to be 24ft. each and two 25ft. 8½in. each, giving a total length over all of 813ft. 3in. The material is required for a bridge to be built over the Murray River at Mildura.

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A CONTRACT was recently signed in Sydney for the building of two modern passenger and cargo steamers for the Australian Oriental Line, controlled by G. S. Yuill and Co., Limited, of Sydney. The new vessels are to replace the Changsha and Taiyuan, and will be built by the Whampoa Dock Company, of Kowloon, Hong Kong. Each vessel will be of about 5000 tons deadweight capacity, and built of steel. In addition to spacious holds for general cargo, extensive refrigerating space for meat and other perishables will be provided.

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IT has been decided to apply the dumping duty to pig iron produced in India, which has recently been imported into Australia at prices which would be detrimental to the Australian metal industry.

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IT is proposed to construct a railway line from Southern Tasmania to the West Coast, and it has been ascertained from the Premier, Mr. Lyons, that there is a possibility of the line being built partly on the responsibility of the Government and partly with the aid of British money. Mr. Lyons said that the matter had received attention in London by the retiring Agent-General, Mr. Ashbolt, who seemed hopeful that satisfactory arrangements would be made by which a British syndicate would co-operate with the Tasmanian Government.

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IN a report recently submitted to the Federal Parliament, the Public Works Committee which has been inquiring into the Canberra railway question, stated that it was convinced that no necessity existed at present for a through railway from Yass Junction, on the Sydney–Melbourne line, to Canberra, but recommended the construction of a shorter line. The estimated cost of the line recommended by the Committee, as obtained from the Commonwealth Railways Department, was £131,000, which, it was stated, was a reduction of £302,000 on the proposed Commonwealth section plus the amount of £310,725 which would have to be spent by the State of New South Wales in completing the line to Yass, thus saving a total of £612,725.

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GENERAL PATON, President of the Newcastle (N.S.W.) Chamber of Commerce, in the course of an address at the annual meeting, stated that steps had been taken to establish the steel wire rope industry at Port Waratah. Some time ago a proposal to open large tin-plate works at Newcastle was well under way, but the promoters found that the cost of water was too high. Reference had been made previously to the advisability of having large power stations at commanding points in the Newcastle and Maitland districts, in view of the high cost of electric current, and he was gratified to learn that one of the largest colliery companies had decided to establish a large station at Cockle Creek. The erection of the cement-making plant at the Sulphide Corporation's works at Cockle Creek was well advanced, and the production of cement would commence early in 1925.

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THE conversion of the first stage of the Western narrow-gauge railway system west of Hamley Bridge, in South Australia, to the broad gauge, is well in hand, and about 80 miles have been prepared for new 60 lb. rails.

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A FURTHER attempt was made recently by the citizens of Newcastle (N.S.W.) to induce the New South Wales Government to undertake the construction of a floating dock at Newcastle. A deputation to the Premier pointed out that a dock had been recommended twice by the Public Works Committee, and had been sanctioned by Parliament. It was estimated that if 25 per cent. of the ships that visited the port used the dock for one day each, it would be a paying undertaking. It was understood that the general manager of Walsh Island had recommended that a two-section dock should be built immediately, and a third section added later on, and that these recommendations were being considered by the Minister for Public Works. The Premier said that the Government was not prepared to go into any more enterprises, but he agreed that a dock was needed at Newcastle, and if, as had been stated, it would be such a good paying undertaking, he was prepared to afford private enterprise every assistance.

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A PROJECT is in hand for the erection of works at Burnie, Tasmania, to convert the iron ore deposits of the Hampshire district of that State into steel and other products. The new company proposes to erect its plant close to Burnie on an area at present served by the Emu Bay Railway Company. Negotiations have already been entered into with the Tasmanian Hydro-Electric Department for the necessary power. The company is particularly fortunate with regard to the supply of flux, as an enormous quantity of limestone exists on the Hampshire property. All manner of iron and steel goods are, it is said, to be manufactured for export.

ACCORDING to the Board of Trade returns the value of the railway material exported during the first five months of the present year was as follows, the corresponding figures for 1923 and 1922 being added in parenthesis :—Locomotives, £1,002,028 (£1,362,326, £2,841,317); rails, £818,183 (£986,318, £1,418,337); carriages, £473,729 (£544,971, £817,573); wagons, £1,623,694 (£1,369,622, £1,926,718); wheels and axles, £296,365 (£451,854, £706,396); tires and axles, £290,408 (£208,851, £229,110); chairs and metal sleepers, £675,866 (£366,825, £1,089,147); miscellaneous permanent way, £561,936 (£471,086, £745,802); total permanent way, £2,740,097 (£2,609,931, £4,288,251). The weight of the rails exported was 91,703 tons (110,251 tons, 136,404 tons), and of the chairs and metal sleepers, 53,625 tons (33,562 tons, 79,752 tons). During the month of May there were shipped locomotives of the following values to the places named :—India, £99,965; Argentine, £71,885; South Africa, £8180; Australia, £5139. Also rails, as follows :—Argentine, £64,902; India, £33,319; British West Africa, £29,929; Australia, £9992; New Zealand, £1238.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Birmingham Quarterly Meeting.

THE quarterly meeting of the Midland iron trade was held at Birmingham to-day—Thursday—when there was a large attendance of representatives from all parts of the country, including a good contingent from South Wales. The market tone was unfortunately uninspiring, and the orders negotiated did not add materially to the quantity of business in hand. Demand for steel and iron, alike raw and finished, was sluggish, consumers apparently having no desire to place forward contracts, being content merely with satisfying their immediate needs. Manufacturers with definite contracts to cover had apparently already closed at present prices, but these instances had not represented such a tonnage as to stimulate the market in the slightest degree. The total volume of business on offer to-day was so small and inconstant that the mood was dispirited. Apart from galvanised sheets, the only department which inspired any faith in the undertone was that which had to do with heavy rolled steel. Demand was steady in that direction, notwithstanding instability in other branches. Midland firms with subsidiary concerns to help out business are assisted to some extent in meeting the very unsatisfactory situation. The inquiries made at the quarterly meeting do not indicate anything in the nature of an early improvement, and little is expected in some circles until the autumn. Fuel, fortunately for the furnacemen, is inclined to be easier, but there is insufficient business for much advantage to be taken of the drop in coke. During the first half of the year the iron and steel industry has passed through a very discouraging time. The struggle has done nothing to solve the problems with which the industry is faced. Present means of production greatly exceed absorptive capacity, and nobody can foretell when the situation will be righted. Some authorities in this area consider it more than probable that equilibrium will only be achieved by relieving the industry of a considerable part of its surplus capacity, for the chances of an increase of demand redressing the balance appear to them very remote.

Staffordshire Iron Trade.

From the conversation between Staffordshire ironmasters on 'Change to-day, one gathers that business is becoming more precarious. Millowners do not see that they would better the position by giving away what margin of profit present prices yield, consequently, idle ironworks are increasing in number. The directors of one of the oldest concerns in South Staffordshire, running several mills, have, it is reported, decided to close down until iron can once more be made at a profit. If the market tone were a true measure of industrial activity, business would be at a very low ebb. The position at the mills and forges is not so desperate, however, as the extreme pessimism of the market would suggest. The marked bar houses continue well off for work, with fair prospects of continued activity. There has been a steady call during the past quarter for best iron on account of the rolling stock industry and some branches of engineering. But the nut and bolt factories and branches dependent on them, it must be admitted, have gone from bad to worse. Ironmasters who re-roll steel for the smaller class of goods, tools, nuts, bolts and the like, however, now report a brisk phase of business, and declare that there is a tendency for trade to expand. The nut and bolt trade is slightly busier, owing to improved shipbuilding demands. Chain makers are also somewhat busier. Re-rolling of steel continues to be the stand-by of a number of local ironworks, unable to get orders for finished iron at the present high price. Steel is increasingly preferred for a variety of uses in which iron was formerly invariably employed, owing to the cheapness of the former. Tube manufacturers have during the past three months had a rush of orders, and the strip mills benefited accordingly. In the pipe foundries there has been a good deal of work.

The Bright Spot.

Though the demand for galvanised sheets has sobered down somewhat, this department is by far the brightest spot in the iron trade at date, and its record for the first half of the year is remarkably good. During the first five months shipments amounted to 280,617 tons, over 20,000 tons more than in the corresponding period last year, which itself yielded very good trade. Many shipments reached the high figure of 66,018 tons. India, Australia, South Africa, the Argentine have all been buying freely since the temporary decline which caused prices to collapse in the spring. Mills are now booked up for about three months, and have tightened their prices almost to the point at which they stood when the year opened. While £18 5s. represents the general price level, some firms require £18 10s. Premiums are paid for early delivery. In a number of instances, makers have declined orders in which supplies are asked earlier than October. A few inquiries have come from America for high-class iron sheets, black and galvanised, America specialising on steel rather than iron. Tin-plates keep firm, owing to heavy bookings. Sellers ask a premium of 3d. or rather more on the new basis of 22s. 7½d.

Raw Iron Prices Deteriorating.

At the quarterly meeting in Birmingham to-day there were far more sellers than buyers in the raw iron department, and values which had already shrunk during the past week or two went even lower. Buyers continued to hold off the market, and there was little evidence, if any, of any prospect of a broadening of consumptive demand in the immediate future. Blast-furnaces in this district have, during the past quarter, been hit harder than any other department of the iron and steel trade. They have had to bear the brunt of coke prices inflated by the export demand, and artificially maintained after the struggle in the Ruhr had ceased to be a dominating factor. With the decline of this demand, furnace coke is now readily obtainable at lower prices, but there is no telling whether the autumn may not bring another "squeeze." Most of the South Staffordshire blast-furnaces have remained idle. The prices obtainable would not admit of competition with furnaces in neighbouring districts which have their raw materials near at hand, and are relieved, therefore, of a large part of the transport charges which South Staffordshire producers have to bear. For the most part, the furnaces which have continued in operation have not been able to dispose of their output, and at the present moment it is reported that as much as four-fifths, in some instances, is being placed in stock. Perturbed by the accumulation of stocks, individual furnacemen have sought to get a larger proportion of what business is going by cutting the price. Other makers have retaliated rather than allow competitors to over-reach them, and prices which were already unremunerative have been further depreciated without adding to the volume of demand. Values of Northamptonshire pig tended to crystallise on the lowest quotations of last week. Derbyshire houses gave more ground, No. 3 foundry being offered down to £4 11s. If a more pronounced concession would have brought good business, smelters would hardly have hesitated. The situation as it has been during the past six months, is shown by the fact that the number of furnaces in blast, taking the kingdom as a whole, has decreased from 204 to fewer than 190, and that, notwithstanding that drastic curtailment of output, stocks on smelters' hands have grown much larger. Pig iron consumers have gone more and more to foreign sources for their supplies. Up to the end of May the imports of forge and foundry pig amounted to 53,289 tons, against 24,377 tons in the same period of the previous year. The increase in basic pig brought in from abroad was still greater, 80,105 tons, against 28,410 tons. Over the same months, our exports of pig iron shrunk from 404,037 tons to 225,244 tons. There can be little wonder that pig iron producers are discouraged, and that pessimism was the predominent note at the quarterly meeting.

Irregular Steel Demand.

Though the steel trade is far from being fully employed, a few works are still able to make full time, largely in execution of railway orders. The outlook for shipbuilding requirements is considered to be more hopeful, and steel makers, on the whole, are fairly bright. Some of the largest plant lately put down has been provided to furnish ship plates, which, it is believed, will be called for in larger quantities, especially in connection with the building of oil-propelled vessels, and the reconstruction of existing craft to adapt the ships for oil burning. During the past quarter plates, except for thin gauges, have been in little demand. Structural steel has not been wanted on any scale commensurate with the increased productive capacity, and prices are shaky. Demand continues small at present, very few contracts being given out. The builders of rolling stock continue to take quantities of steel for frames, &c., owing to the high price of iron. Some lines, however, are reverting to wood as the principal material, the all-steel wagons of America not being popular in this country. Some Midland mills are still running on heavy rail orders for home and foreign railways, and have fair margins left to provide work for some time. Complaints are general, however, of unprofitable prices, but no improvement in this direction is in sight. It seems to be generally agreed that shipbuilding promised to be one of the most useful consumers of steel in the future. An increasing number of steel works are producing semi-finished material for stock in the absence of adequate new business. Belgian competition continues a prominent feature, mainly on account of the prevailing low currencies. Large quantities of semi-finished steel are being shipped to Newport, Cardiff, &c., a fairly heavy proportion of which finds its way to South Staffordshire for re-rolling by plant unable to get sufficient iron business. Quotations for steel are unaltered. Outside heavy structural material, orders are meagre.

Engineering.

Business in the engineering industry in the Midlands has during the past quarter advanced, though, it must be admitted, irregularly. Those branches which are directly benefited by the large public works put in hand in the ordinary course of development or with the object of inspiring a new trade movement, have increased their turnover. Undertakings which depend upon private enterprise have not been initiated on such a scale as to give any concerted impetus to trade. Rolling stock makers have continued well employed, if they have not greatly fortified their position by additional contracts.

Workless.

Again this week there has been a decrease in unemployment in the Midlands area, and though the fall is only one of 656, it is none the less welcome, especially at this period of the year when industry is notably less active than at the beginning or end of the year. The total number of unemployed in the area is now 128,736, made up of 95,530 men, 2132 boys, 28,532 women and 2542 girls. The decrease noted was spread over the following local towns:—Birmingham, Coventry, Bilston, Cradley Heath, Dudley, Smethwick, Stourbridge and Brierley Hill, Oldbury and Tipton. Increases were recorded at Wolverhampton, West Bromwich and Walsall.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

There has been no definite change for the better in the iron and metal markets yet. Politicians seem very fond of making optimistic speeches as to the coming revival of trade, but the business man sees no justification for this attitude. What would certainly give a fillip to all Manchester business would be a big cotton crop in America, and a consequent fall in cotton prices great enough to enable our impoverished customers to buy what they need; for this would quickly react on Lancashire engineering and stimulate the local demand, both for iron and the non-ferrous metals; but the possible benefit to be derived from a return to normal cotton production in America is yet a long way off; and it seems unlikely that any serious effect will be produced this year. The reconstitution of industry proceeds very slowly, and it is quite unphilosophical to look for any sudden and rapid improvement in the general conditions. The system of international business has to be rebuilt.

Metals.

There seems to be a growing belief in the copper market that prices are on a safe level, and that when the next movement comes it must be on the up-grade; but opinions differ as to when this movement is likely to occur. The practice here amongst consumers is to buy in small lots and for prompt use, and to leave the future to take care of itself; and the fact that few if any amongst the consumers expect any more favourable buying prices does not have the normal effect of inducing them to hold large stocks. There is no expectation of a fall, but at the same time there seems to be no fear of a rise; and as capital is not too plentiful, it is natural to decline to lock any up by investing it in stocks of copper. A sharp upward movement in copper prices would, of course, shatter this complacent feeling on the part of consumers, and it is this that the market is waiting for. Prices for refined copper in Manchester have scarcely changed at all during the last three or four weeks. The quotations for manufactured copper and brass are also practically unchanged, and still show a very large margin to cover the costs of manufacture. Reports from America recently seem to indicate that the copper trade there is placing its hopes in the revival of the European, and particularly the German, demand as a consequence of the carrying out of the Dawes scheme for settling the "Reparation" question. A very big increase will be needed, or else a very big decrease in American output this year, if the general statistical outlook is to be changed for the better. The figures recently published officially in America show how recklessly excessive was the output of copper in 1923. In the market for tin there is as yet no very definite news as to the future course of the market. Those who were predicting an advance to £250 are not quite so confident as they were. In Manchester over £230 was reached at one time, but was not maintained. The market at present seems inclined to wobble between £220 and £230 per ton, and in the present state of trade one would be inclined to say that this was quite high enough. Lead keeps in a very doubtful position, and the "backwardation" remains at about £3 per ton. Apparently a good deal of lead has to come forward, but at the moment the supply is small. Spelter is fairly steady with very little, if any, change in the outlook. The price is quite low enough, however, and any revival of demand ought to lead to an advance.

Pig Iron.

The demand for foundry iron in the Manchester district seems smaller than ever. Merchants complain that they get no orders, and although the selling agents for the furnaces do not grumble very much, it is believed that pig iron is again beginning to accumulate, and some anxiety is felt as to the future. Consumers here are confirmed in their belief that lower prices are coming, and this conviction will not be shaken until a distinct upward movement has been established. The concessions on coke, such as they are, have already been given away in the price for foundry iron, which is now, on an average, about 3s. per ton lower than it was when coke was sold—without any question of analysis—at 24s. Really good furnace coke, say, with only 10 per cent. of loss from moisture and ash, would still cost 24s. to 24s. 6d. per ton under the new arrangement; it is only coke with 20 per cent. loss which is to be had at 20s. 6d. One is inclined to think that the profits on pig iron making are, if anything, more precarious than they were before; but, of course, this does not imply that the selling price cannot come down. It is more probable that a further fall of 4s. to 5s. per ton would be required to induce many of the producers to blow out furnaces in the Midlands. Apparently about 98s. per ton on trucks is about the present selling price for No. 3 Derbyshire foundry iron delivered in this district, or perhaps as low as 90s. at the furnaces. Cleveland iron is at about 88s. or perhaps 87s. 6d. at the furnaces, so that it still costs rather more than the Midland irons when delivered here. Scotch iron has not been reduced here, and, in fact, Scottish makers are said to be resolute on the question of blowing out rather than submitting to any further fall.

Steel.

The situation in the market for finished steel is just the same. Demand is reduced to a minimum, and although prices are nominally unchanged, it is fairly certain that the works are weaker, and more inclined to make concessions if there is any chance of securing a big order. There is no sign yet of any improvement in the prospects for ship plates or for sectional steel. Foreign material is offered here at about £2 per ton below the nominal British prices, but one does not hear that there is any very large business even at such tempting rates. The uncertainty of exchanges and of time of delivery still stands in the way of business.

Scrap.

The market for scrap iron and steel is very much as it was, except that steel scrap seems weaker again. In Lancashire the price for heavy steel melting scrap is still given nominally as 75s. per ton on trucks; but apparently 85s. delivered in Sheffield is rather more than the steel works there are inclined to pay; and the South Wales price would leave a loss on 75s. after the carriage was paid. In fact, for the South Wales market steel scrap in Lancashire is not worth 70s. per ton. Wrought scrap is not in such good demand now, and the lower

price for forge pig iron renders the Lancashire iron manufacturers less eager to buy scrap. Foundry scrap is quiet and weaker, and probably dealers could be found who would accept less than 90s. for really good lots of broken machinery metal.

A Giant Universal Plano Milling Machine.

I had an opportunity recently of inspecting, at the works of its builders, Kendal and Gent (1920), Limited, of Manchester, the largest plano milling machine which I have ever seen. It has been built to the order of the North-Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne, primarily for machining the segments of large Diesel engine beds, but it is so constructed as to be equally applicable to other large castings. The machine can also be used for heavy slab milling by means of a horizontal mandrel, which is carried right across the machine and is driven by both horizontal spindles or from one side spindle only, in the latter case a stay being provided for supporting the mandrel at one end. The machine is electrically driven, and has four milling saddles, two with vertical spindles on the cross slide, and one on each upright with horizontal spindles. The two vertical spindles are balanced by springs, and each is independently driven by a 30–35 horse-power electric motor. Each spindle is fitted with slow variable feed and quick run motion along the cross slide, the feed for each spindle being manipulated either to the right or left or stopped independently or simultaneously. A slip motion is provided to avoid damage in case one saddle is fed against the other one. The sideheads are fitted with variable milling feeds as well as with a quick run motion up and down, on the face of the upright, and these motions can be operated either separately or together, or simultaneously with the vertical spindles on the cross slide for slab milling. The side heads are balanced, the spindles being driven by 160–170 horse-power variable speed motor carried on a base at the left-hand side of the machine and coupled direct to the first driving shaft by spur gears. The cross slide is about 28ft. long and, including the saddles, weighs 28 tons. It is partially balanced. The table is 12ft. 6in. wide, and is provided with three bearing ways and holding down strips inside and outside. It is moved by twin worms—with heavy ball thrust bearings—gearing into two semi-circular racks, an equalising motion being fitted so that both worms automatically take an equal share of the work in moving the table. In addition to the power feeds and quick runs already referred to, a hand motion is provided at the base of the right-hand upright, which gives the operator an opportunity of adjusting one or both saddles on the cross slide or the side heads on the upright simultaneously. The face cutters are 24in. diameter. The feed and quick-run motions are driven by an independent 20 horse-power reversing motor coupled direct to a change speed-box, giving a wide range of feed with constant speed quick runs. The capacity of the machine is as follows:—Length, 18ft.; width, 12ft.; height admitted under vertical spindle cutters, 8ft.; and the total weight of the machine is about 140 tons. When cutting at its full capacity, it is estimated that the machine will remove about 160 cubic inches of cast iron per minute.

The Institution of Mechanical Engineers.

On Wednesday, the 2nd inst., about a hundred members of the North-Western Branch of the Institution of Mechanical Engineers, paid a visit to the Leyland Works of Leyland Motors, Limited. As the company's works cover over 150 acres, and with very few exceptions every part of the firm's products is manufactured from the rough, the visitors had a busy afternoon. The diverse nature of the company's productions, including petrol vehicles of every description, for goods, passenger, and municipal services constitutes a difficult manufacturing problem, necessitating a system which has to be exceedingly flexible. Production is carried out on the principle of working to maximum and minimum finished stores stocks, and the building of standard unit assemblies. There is being established a central control office, which will work in conjunction with the planning department, in which the movement of components from operation to operation is directed and expedited by the use of a novel form of control board, indicating the exact operation and part in progress at each individual machine. The system gives the necessary flexibility to enable the various types of vehicles to be dealt with in accordance with a predetermined programme. The shops themselves, including milling, drilling, turning, grinding, gear cutting, erecting, wood-working, coach-building and sheet metal working, grouped progressively and equipped with modern plant, are laid out to facilitate rapid transportation of material by means of special lift trucks. The system of inspection is not only exceptionally thorough but is introduced immediately after the "dressing" stage, in the case of machined parts to obviate the unnecessary additional transfer to a separate inspection department. Chassis erecting is carried out on "line-construction" principles, with a special bay for non-standard machines. The chassis are turned out complete from the North Works, subjected to their road tests, and ultimately transferred to the South Works across the road, where are grouped the body-building, painting and finishing shops.

BARROW-IN-FURNESS.

Hematite.

There is no change to report in the state of the hematite pig iron trade in this district. Business is not on a big scale. There is no tendency to place orders for future deliveries, and if it were not for the requirements on account of the steel departments there would have to be a curtailment of production, for makers are not inclined to allow stocks to accumulate. That means idle money. There are suggestions that customers are holding off from placing large orders to cover present and future needs in the hope that prices may fall, but amongst iron producers there is no hope held out of such a thing happening. They say that present prices leave them little or no margin. Parcels—none of them large—are regularly being delivered to customers in Scotland, the Midlands and South Wales, and some time ago, in view of heavier orders being placed with engineers and shipbuilders, it was hoped that business would increase. It has not done so to any appreciable extent. The foreign rate of exchange is operating against overseas trade.

Iron Ore.

The iron ore trade, generally speaking, is dull, and although three local mines have started raising ore again, none of them are anything like fully employed, and the same remark applies to other mines which have been engaged for some time. The most activity is in Cumberland. Foreign ores are in limited demand, and are likely to be.

Steel.

The steel trade is not very brisk, and such contracts as are obtainable are much competed for, and prices mentioned do not tempt makers. The rate of foreign exchange is a factor to be considered here, and is enabling continental makers to secure certain orders. The rail mill at Barrow is still working, but the prospect of a protracted running is not very promising. The mills in Cumberland will start for a short run in a week or so. Hoop and section mills at Barrow comparatively busy.

Shipbuilding and Engineering.

There is a dispute at Vickers' yard, and the rivetters are out on strike, but there are hopes of a settlement this week. It is very unfortunate that this should happen when the yard is so busy. A conference which met the other day broke up suddenly. The matters under dispute should not require much adjustment. Three L.M.S. passenger steamers, including the Anglia, are lying up at Barrow. It is rumoured that the Anglia, a 26-knot boat, may be put on the Heysham-Douglas service. If this is correct, there will be some interesting "bouts" with this vessel and the Isle of Man Steam Packet Company's ships, none of which can claim to have such a turn of speed. Rumour may be a lying jade though. There is considerable satisfaction locally as a result of Vickers Limited having secured orders for the heavy gun mountings for two of the 10,000-ton cruisers, one of which is being built at Barrow. Vickers are already engaged on the smaller mountings for the two capital ships being built at Tranmere, Birkenhead, and Armstrong-Whitworth's. The number of hands employed at Vickers' Barrow works is now about 10,000.

SHEFFIELD.

(From our own Correspondent.)

Depression in Mild Steel.

THE condition of things in the mild steel trade of Sheffield and district goes from bad to worse. The falling off in the demand for basic billets continues, and not only at the furnaces but also at the rolling mills and forges and in merchants' offices, the general opinion is that the trade tide has reached a very low ebb, and shows little sign of turning. The leaders of Sheffield industrial thought have consistently preached optimism and put the most cheerful face on the position, but the Master Cutler, speaking at the Forfeit Feast last week, could only describe himself—in spite of Sir George Paish's statement that we are within sight of a wonderful trade revival—as "a modified optimist," and could make no better prediction than that prosperity would be restored "in due course, in God's good time." In the meantime, a large proportion of the open-hearth plant of the district is standing. This is partly due to lack of orders, and partly to stocktaking. The plant of Messrs. Steel, Peech and Tozer at the Ickles is running, but the same firm's range of fourteen large furnaces at Templeborough is standing, and it will only be possible to relight a few of them after stocktaking, unless there is an immediate increase in the number of orders coming in. This firm will receive some help from an order for 1000 tons of tram rails which has been placed with it by the Sheffield Tramways Committee, at the price of £13 per ton. The railway steel departments remain in about the same state as was reported last week. They have a large amount of work on hand, but not sufficient to keep them fully employed.

The Lighter Branches.

The condition of things here is rather better than on the heavier side. Operations are at present curtailed on account of stocktaking, but in several directions there is evidence of improvement. This applies to crucible steel, which goes largely into the manufacture of tools for engineering purposes. The trade has been in a very unsatisfactory state for four years, owing partly to the small demand and partly to the existence of Government surplus stocks, but now it appears that the one condition has improved while the other has fallen away, and at present makers of the material are doing better. The trade has had so many ups and downs since the war, however, that one feels it safer merely to state the present fact than to prophesy as to the future outlook. Finished tools and files are being produced in larger quantities than was the case a year ago. The saw trade, which has been doing well for a considerable time, maintains its activity in both circular and hand articles. A good position is also reported in regard to hacksaws, which continue to increase in reputation and to sell more freely.

Stainless Steel and Iron.

Good progress continues to be made in the application of stainless material to new and old purposes. The demand for steel of this quality, for the cutlery trade, keeps up to a high level, while rustless iron, which is considerably cheaper, is making good headway in engineering and other branches. The production of castings from this material is achieving considerable success. The adoption of this iron generally, however, or for purposes which require large quantities, is still retarded by the high price. Experiments are being carried out with a view to its use in the wire trade for the best goods. Half-a-dozen of the local steel houses which cater for the demand for stainless metal find it a good side line which helps their activities substantially, but profit is interfered with by the necessity for carrying on continuous research and experimental work.

Cutlery and Plate.

A somewhat better tone characterises these trades. Not only is there a continuance of the large demand for the cheaper grades of stainless cutlery, to which I have made repeated references, but the best brands of table knives are selling more freely than for a considerable time past. It is interesting to know that, popular as stainless cutlery has become, it has not quite secured the whole field to itself, as some large consumers, including shipping and railway companies, continue to ask for the old-fashioned shear steel blades. The trade, as a whole, is enjoying a better demand from overseas markets, which is no doubt due in part to the financial and other difficulties prevailing in Solingen and the consequent falling off of competition from that quarter. There is a growing business in Sheffield scissors and spring knives, but at present it is on only a moderate scale, the total output being much below the average of pre-war years. There is an improvement in the sales of the best qualities of electro-plate. This is almost entirely on export account. Not only is a better trade being done with the Dominions, but—a specially gratifying feature—business is being resumed with a number of foreign markets which have been stagnant for a long period. The home trade remains in a very poor condition, so far as good class ware is concerned, and it is noted that there is a falling off in the quality of sports trophies and prizes, owing to the call for cheapness, although the quantity purchased compares well with previous seasons. The demand for cheap spoons, forks and other table ware is on a very large scale.

The Price of Coke.

A conference of ironmasters and coke makers has agreed upon a sliding scale of prices for blast-furnace coke, based on the proportion of ash and moisture. The recent basis price has been 24s. per ton at the ovens. Now, it has been agreed that the basis shall be 24s. 6d., provided that the ash and moisture content is not more than 10 per cent. If it reaches 11 per cent., the price is to be 24s. 1d.; 12 per cent., 23s. 8d.; 13 per cent., 23s. 3d.; 14 per cent., 22s. 10d.; 15 per cent., 22s. 5d.; 16 per cent., 22s.; 17 per cent., 21s. 7d.; 18 per cent., 21s. 2d.; 19 per cent., 20s. 10d.; 20 per cent., 20s. 6d.

A New Bridge at Sheffield.

An important bridge scheme is to be carried out at Broughton-lane, where a new road is to be made over the Great Central Railway and the adjoining canal. The council has authorised the sealing of a contract for £24,450 for the construction of the new bridge, and various road improvements in connection with the scheme will bring the total expenditure up to £37,000.

Colliery Developments.

Mr. Herbert Greener, the chief engineer for Pease and Partners, Limited, reports that a seam of good coal, 5ft. 2in. thick, believed to be the Kent Thick, has been intersected during the sinking operations at Thorne Colliery, near Doncaster, at a depth of 860 yards. Sinking is being continued to the Barnsley seam. A project for the equipment of a new colliery, on modern lines, at Papplewick, seven miles from Nottingham, is reported. This is an enterprise of the Babbington Coal Company, with which Sir Charles Seely and his brother, Colonel Frank Seely, are actively associated. In connection with this development a new line will be constructed from the Leen Valley branches of the London, Midland and Scottish and the London and North-Eastern Railways.

Cheaper Gas and Electricity.

Leeds is to have cheaper electricity, and Bradford cheaper gas. In the former city, the price of current for power purposes has been brought down to pre-war figures, the maximum being 1½d. per unit, with substantial reductions for large consumers. For cooking and other heating purposes, the maximum is to be 1½d.—a reduction of a farthing—with a sliding scale under which consumers of 20,000 or more units per quarter will be charged nine-tenths of a penny per unit. Private householders may take advantage of the Residential Bulk Supply Tariff, and obtain current for all purposes, including lighting, at an all-round price of ¼d. per unit, with the addition of a fixed charge of 15 per cent. per annum upon the net rateable value of the consumer's premises. For lighting purposes, the maximum charge is reduced by a farthing to 5d. per unit. The reductions are expected to cost the Corporation £58,000 per annum, but, as an expansion is taking place in the business, it is believed that the undertaking will be well able to bear the loss. At Bradford the reduction in the price of gas is 3d. per 1000 cubic feet as from July 1st, making the new charge 3s. 9d. per 1000 to domestic consumers and 3s. 2d. to industrial consumers, the rates of discount remaining the same. The gas undertaking made a net profit last year of £38,427, as compared with £25,301 in the previous year. A sum of £13,000 has been appropriated to the relief of rates.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

A SLIGHT improvement is recorded in the Cleveland pig iron trade this week. There was plenty of room for it. Business fell to its lowest ebb last month, and makers' order books have become very lean. With the franc still slumping, conditions are entirely unfavourable to a revival of the export trade, but home consumers are now displaying a little more interest in the position, and as

a matter of fact, there has been rather a spate of business during the past few days. Of course, the improvement is only relative, and what is wanted is not a sudden spurt and then a relapse, but rather a sustained buying movement. Of that there is still no indication, but at all events even this slight turn for the better is welcome, and it is reflected in the firmer attitude of the ironmasters, who are now quoting 88s. 6d. per ton for No. 3 G.M.B. Cleveland pig iron. There are still second hands prepared to sell at 88s., and even 87s. 6d. per ton, but 88s. 6d. per ton is a minimum f.o.b. price, although makers might possibly shade that figure for truck iron. There is not a great deal of No. 4 foundry iron about, but it can be bought at 87s., and No. 4 forge at 86s., whilst No. 1 foundry iron is not less than 93s. per ton.

Hematite Pig Iron.

East Coast hematite pig iron has not as yet shared in the improvement, but a more cheerful view is taken of the outlook, and a renewal of active buying is expected in the near future. This week another furnace has been blown in at the Ormesby Ironworks for the production of hematite. Mixed numbers can still be bought freely at 96s. per ton, although some makers ask 96s. 6d.

Ironmaking Materials.

The foreign ore trade is completely idle, and consumers are reluctant even to take contract deliveries, although the low freight rates now ruling present a favourable opportunity for shipment. Best Rubio ore is nominal at 23s. per ton c.i.f. Tees. The export trade in coke is rather better, and this tends to stiffen the price of blast-furnace coke, which is now about 27s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

Discouraging accounts continue to be given of the manufactured iron and steel trade. Orders are scarcer than ever, and manufacturers are having considerable difficulty in keeping their works in operation. Prices are at a very unprofitable level, and some makers are prepared to shade quoted prices in order to secure work.

The Coal Trade.

The position in the Northern coal trade is very discouraging. The market remains bare of pressure of any orders, and fitters are still dependent on contractors' requirements to keep the pits at work even at the moderate average of the past few weeks. Competition in all markets is keen, and although locally prices asked are much below home competing centres, buyers fail to respond. The Germans, owing to low prices, are getting a strong hold in France and other centres, and the low freight rates from American ports enable shippers to compete successfully in the Italian and French markets. Badly as many of the North Country pits have been working recently, they have little better prospects for the next week or two, and for later the position is unfathomable. Fitters cannot understand the relative high prices ruling in Yorkshire and Wales, with the local prices at so much easier values. Prices asked for Northumberland steam coals are very low as compared with best Welsh—somewhere in the neighbourhood of 8s. per ton—yet the Welsh collieries have plenty of trade. Yorkshire also appears to have plenty of trade at prices substantially higher, and even Scottish qualities, which are usually less than Northumberlands, are at present securing trade at much higher prices. Under the circumstances, there is a growing disposition in the Northern market to hold on till consumers are educated up to the fact that the market has touched bottom. Forward there is a steady holding off and contract inquiries for over the remainder of the year are being held back. There is a little more demand for coke, more especially for gas makes, and the demand is slightly above the output, so that quotations rule steady.

Blast-furnacemen's Wages Reduced.

The ascertainment issued by the Cleveland Ironmasters' Association this week certifies that the average net selling price of No. 3 G.M.B. Cleveland pig iron for the past quarter was 89s. 4.13d. per ton, a drop of 6s. 4.81d. per ton as compared with the realised price for the first quarter of the year. In accordance with the sliding-scale arrangement, this means a reduction in blast-furnacemen's wages of 6.25 per cent., which will bring the wages from 28 to 21.75 per cent. above the standard. The reduction takes effect from the 6th inst.

Iron and Steel Imports.

Returns issued this week by the Tees Conservancy Commission show the quantities of iron and steel imported to the Tees ports from the Continent, India, and coastwise for the eight months ending June last, as compared with the same months a year ago and the corresponding pre-war period of 1913–14. Pig iron imported to the end of June totalled 15,740 tons, as against 5557 tons a year ago and 213 tons in the pre-war period; crude sheet bars, billets, blooms, slabs, &c., brought in during the last eight months reached 50,560 tons as compared with 49,881 tons a year ago and 30,307 tons in the pre-war period; and plates, bars, angles, rails, sheets and joists unloaded to the end of last month amounted to 12,081 tons, as against 8549 tons a year ago and 17,419 tons in the pre-war period.

SCOTLAND.

(From our own Correspondent.)

General Conditions.

So far as the general situation can be gauged, markets are just moving and no more. The average amount of business being done in steel, iron and coal is very low, and only here and there is there any sign of activity. As is usual at this period of the year, a little extra purchasing to cover requirements over the holiday season is reported. Makers, too, are fairly confident that conditions will show an improvement after the holidays. Owing to the unsatisfactory nature of business at present, the holiday season may be extended.

Pig Iron Weaker.

No definite sign of improvement is noticeable in the pig iron trade. Demands for hematite and foundry qualities are easily satisfied, and the tone is weakening. The export market is a dull one. At the moment, hematite is approximately quoted at £5, No. 1 foundry £5 1s. 3d., and No. 3 foundry £4 16s. 9d.—all per ton delivered Glasgow—but something below these figures could be done if a good order were in prospect.

Steel.

General demands for steel material are unsatisfactory, in view of the number of shipbuilding contracts recently given out. Neither plates nor sections are well placed, the former being particularly slow. For home delivery, prices are unchanged at £13 10s. boiler plates, £10 5s. ship plates, ¾in. and up, and £10 per ton for sections. Export demands for thin sheets have been extensive, and works are well placed for some weeks ahead. Galvanised corrugated, 24 b.g., sheets have firmed to £18 10s. per ton, f.o.b. Glasgow, and tend to rise further. South Africa, India and South America are the chief buyers. Heavy sheets are a poor market.

Bar Iron.

New business in bar iron is scarce. Orders have been a shade better recently, but the total quantity is small. Re-rolled steel has better demands. A fair business has been done in rounds for ferro-concrete work. Crown bar iron is a poor seller at £12 10s., home delivery. Re-rolled steel remains about £9 15s. per ton, home or export. The market for scrap material is quieter than is usual at this time of the year.

Coal: Restricted Exports.

The position in the coal trade is practically unchanged. Many collieries are already working reduced shifts, while others are making arrangements to cut down production. On the whole, the inquiry from abroad is small in respect to prompt business, and practically of no account so far as forward transactions are concerned. Buyers will not purchase largely for prompt delivery while prices are weakening, and are quite determined against the prices asked by owners for forward transactions. Lanarkshire splints have been a shade steadier, owing to shipments against contracts being due, and to the fact that outputs have been reduced. Ells also are a trifle steadier. Other descriptions are weak, however. In the Lothians the output is considerably beyond the demand, and the tone is weak all round. A fair quantity of the Fifeshire output is absorbed by Swedish State Railway contracts. Inquiries from Spain are most prominent at present. Germany, France, Belgium and other adjacent countries are hardly moving meantime. Aggregate shipments for the past week amounted to 258,362 tons, against 262,490 tons in the preceding week and 335,183 tons in the same week last year. The outlook in the home market is anything but satisfactory. The general industrial slackness has reduced buying to a minimum, while the household demand is, of course, low at this season of the year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THESE are very dull days in the steam coal trade, although, of course, everything goes by comparison. But even allowing for this, it has to be acknowledged that business is far from brisk and the evidence of this is to be found in the lack of loading pressure at practically all the docks. The arrivals of tonnage over last week-end were below expectations, and on Monday there were thirteen loading berths idle with only seven steamers waiting turn. This is not at all satisfactory for the start of the week, and gives the impression that quite a number of collieries will experience before the end of the week difficulties in maintaining regularity of work at their pits, unless there is meantime a distinct improvement in the supply of tonnage. In these circumstances, one would naturally look for an advance in freight rates for prompt tonnage, but the market does not on this occasion show such a tendency, which indicates that orders are none too plentiful in comparison with the tonnage offered for employment, or that tonnage has been chartered but is backward in arrival. The leading collieries are reported to be well stemmed, so that prices for the best coals for shipment this month are likely to be well maintained, but for August the outlook is not so promising, though no appreciable falling away is expected. The fact that during the first week of next month holidays will be taken means that fully half a week's output will be lost, and production throughout the whole of that month will in all probability be below the average on account of leave-taking. This should have a steadying effect upon prices. At the moment the foreign demand continues to be quiet, and what inquiries are on the market are for the most part for single cargoes, as has been the case for several weeks past.

Miners' Wages.

Dealing with the question of the wage rate for miners last week, a mistake was made in stating that the rate was decided for the current month and August. Under the new wages agreement, a change has been made in the method of calculation, as it was agreed that instead of the audit covering a period of two months, it is to cover a period of three months, and the wage rate is to be revised monthly. Under this arrangement, therefore, the general wage rate for July is decided by the results in March, April and May, and that for August will be determined by the audit for April, May and June. With regard to the results of the period upon which the wage rate for this month has been decided, a fact, which is disclosed by the secretary of the Coalowners' Association in a statement issued by him, causes a feeling of some uneasiness, and it is that in the month of May the trading profit amounted to only 2¼d. per ton. The statement points out that in May last £2,675,595 was paid in wages alone for the production of 4,123,621 tons, while for the same quantity of coal in 1914 the wages paid amounted to only £1,580,721. There is therefore an increase of no less than £1,100,000 in the wages bill, which is equal to an annual increase of about £12,000,000. Other costs have also increased considerably, and taking the two items of wages and other costs, they amounted in May to no less than £1,617,583, or 7s. 10d. per ton over the wage and other costs of producing an equal quantity of coal in May, 1914.

M.F.G.B. Conference.

The Miners' Federation of Great Britain has been holding its annual conference this week at Swansea, and in the course of his presidential address on Tuesday, Mr. Herbert Smith stated that the seven-hour day would not be given up at any cost. They would press for the continuation of the welfare fund, and every effort would be used to obtain at least 2d. per ton from the royalty owners to add to this fund to form a nucleus for the fund for mine workers when they could no longer follow their employment. As regards the organisation of the Federation, Mr. Smith pointed out that in 1912 the number of persons employed in and about the mines was 1,089,090, with a Federation membership of 586,000; but in 1924, the number employed was 1,192,300, and the number of Federation members was 788,520, an increase of 38,660. There was still need for organisation, but he hoped that the conference would not hesitate to agree to the Executive's resolution for a uniform contribution of 1s. per week, and a determined effort be made to get every miner organised. Mr. Smith further stated that more provision would have to be made in respect of safety appliances in mines.

LATER.

The annual conference of the M.F.G.B. at Swansea has passed a resolution that the Federation is of the the opinion that the time has arrived that an universal day-wage system should be established. It was also decided that the executive committee be instructed to continue to press that membership of the Federation shall be a condition of employment at collieries. The mover of the latter resolution, Mr. Noah Ablett, of South Wales, said that he had reluctantly come to the conclusion that voluntary organisation is a failure.

Steel and Coal Items.

The announcement is made that the Blaenavon Company decided to restart one of its biggest blast-furnaces on Monday last, with the result that employment would be available for 150 men immediately. At the end of last week about 5000 men employed at collieries in the Garw Valley struck work on the non-unionist question, but fortunately the strike terminated early this week, as all the non-unionists have cleared up their arrears. About 1000 miners engaged at the Mardy Colliery, Rhymney, received fourteen days' notices on Saturday last to terminate their contracts on the ground that the colliery is unremunerative. It is also reported that about 1000 miners at the Rhondda Main Colliery, Ogmore Vale, have received notices on account of slackness of trade, but it is hoped that the stoppage will not be of long duration, as it is understood that it is the intention of the owners to develop the undertaking.

Building Strike.

As regards the building operatives' strike, it is stated that about one hundred agreements have been entered into in South Wales. At Cardiff about 2500 are affected, but up to Monday night it was reported that twenty-one firms had signed the provisional agreement. At Swansea between two and three thousand men are concerned, but on Monday it was found possible for about 1900 men to resume work, the employers who have conceded the demands of the men being outside the Federation of Master Builders. The strike committee also permitted work to restart on Tuesday on the Corporation housing schemes.

Current Business.

Current operations have been of comparatively small account, and the tone of the steam coal market is quiet. Best Admiralty large continue to be the steadiest section of the market, and range about 28s. 6d. to 29s., but other qualities are somewhat irregular. Smalls are for the moment fairly plentiful, especially the inferior grades, but there is a prospect of these coals becoming steadier, on account of production falling off. Patent fuel shows no change, while coke is without alteration. Anthracite coals are in fairly good request all round, and are steady.

CATALOGUES.

H. C. SLINGSBY, 89-95 and 97, Kingsway, W.C. 2.—List No. 242 on the Slingsby Jacklift.

STEAM FITTINGS COMPANY, Limited, West Drayton, Middlesex.—List giving the principal manufactures of the company.

SULZER BROS., 31, Bedford-square, London, W.C. 1.—Booklet on the two-cycle Sulzer Diesel engines with airless injection.

MARSHALL, SONS AND CO., Limited, Britannia Ironworks, Gainsborough.—Publication No. 1427 on the "Marshall" steam road rollers; also publication No. 1430 on "Marshall" locomobile engines.

JOSEPH SANKEY AND SONS, Limited, Hadley Castle Works, Wellington, Shropshire.—Catalogue of wheels for motor cars and commercial vehicles, panels, mudguards, radiator cowls, dashes, chassis frames, axle cases, brake drums, foundry ladles, barrow bodies, steel barrels and miscellaneous pressings for the railway, shipbuilding and general engineering trades.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/–
(1) Spanish	23/–
(1) N. African	23/–
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 0 0	—
No. 1 Foundry	5 1 3	—
No. 3 Foundry	4 16 3	—
N.E. COAST—		
Hematite Mixed Nos.	4 16 6	4 16 6
No. 1	4 17 0	4 17 0
Cleveland—		
No. 1	4 13 0	4 13 0
Silicious Iron	4 13 0	4 13 0
No. 3 G.M.B.	4 8 6	4 8 6
No. 4 Foundry	4 7 0	4 7 0
No. 4 Forge	4 6 0	4 6 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 5 0	—
„ „ Foundry	4 12 6	—
(3) Northampton—		
Foundry No. 3	4 7 6 to 4 10 0	
„ Forge	4 0 0 to 4 3 0	
(3) Derbyshire—		
No. 3 Foundry	4 10 0 to 4 13 0	
Forge	4 7 6	—
(3) Lincolnshire—		
No. 3 Foundry	4 12 0	—
No. 4 Forge	4 13 0	—
Basic	4 11 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 11 0 (a)	—
	5 17 6 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E COAST—		
Common Bars	12 10 0	—
LANCS —		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 10 0	—
Best „	14 0 0	—
Hoops	15 0 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 3/16in. to ½in.	13 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	10 0 0 to 10 10 0	
Billets and Sheet-bars	7 12 6 to 7 15 0	
Sheets (29 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 5 0	—
Angles	9 17 6 to 10 0 0	
Joists	9 17 6 to 10 0 0	
Tees	10 17 6 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	22/7½ to 23/–
Block Tin (cash)	225 0 0
„ (three months)	226 5 0
Copper (cash)	60 12 6
„ (three months)	61 12 6
Spanish Lead (cash)	32 2 6
„ (three months)	29 17 6
Spelter (cash)	31 15 0
„ (three months)	31 10 0
MANCHESTER—	
Copper, Best Selected Ingots	67 0 0
„ Electrolytic	67 10 0
„ Strong Sheets	92 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
„ Condenser	0 1 2
Lead, English	34 15 0
„ Foreign	33 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
„ 6 p.c. to 8 p.c. „	£23 10 0	8/–
„ 8 p.c. to 10 p.c. „	£23 0 0	8/–
„ Specially Refined		
„ Max. 2 p.c. carbon	£42 10 0	16/–
„ „ 1 p.c. „	£51 0 0	17/6
„ „ 0.75 p.c. carbon	£68 0 0	20/–
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/– per unit	
„ „ 75 p.c.	£18 10 0 scale 6/– per unit	
„ Vanadium	10/3 per lb.	
„ Molybdenum	8/3 per lb.	
„ Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£120 to £130	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/6
„ „ Ell	18/9
„ „ Splint	20/– to 22/6
„ „ Trebles	19/–
„ „ Doubles	19/–
„ „ Singles	17/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/3
„ „ Splint	20/–
„ „ Trebles	19/–
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	16/6 to 20/–
Screened Navigation	26/–
Trebles	20/6
Doubles	18/9
Singles	17/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	17/–
Secondary Steam	16/6
Trebles	19/–
Doubles	18/9
Singles	17/3

ENGLAND.

(8) N.W. COAST—	
Steams	30/–
Household	45/– to 58/4
Coke	33/6
NORTHUMBERLAND—	
Best Steams	19/6 to 20/–
Second Steams	19/–
Steam Smalls	11/6 to 12/6
Unscreened	16/– to 18/–
Household	27/–
DURHAM—	
Best Gas	23/– to 23/6
Second	19/6 to 20/6
Household	27/–
Foundry Coke	27/6 to 29/6
SHEFFIELD—	Inland.
Best Hand-picked Branch	34/– to 35/– —
Barnsley Best Silkstone	28/– to 29/– —
Derbyshire Best Brights	28/– to 30/– —
„ „ House	25/– to 27/– —
„ „ Large Nuts	24/– to 25/– —
„ „ Small „	18/6 to 20/6 —
Yorkshire Hards	23/– to 24/– —
Derbyshire „	21/6 to 23/6 —
Rough Slacks	12/6 to 15/6 —
Nutty „	12/– to 14/– —
Smalls	8/– to 10/– —
Blast-furnace Coke (Inland)	20/6 to 24/6 —
„ „ (Export)	f.o.b. 25/– to 26/–

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	28/– to 29/–
Second „ „	27/– to 28/–
Best Dry Large	26/6 to 27/–
Ordinary Dry Large	25/– to 26/–
Best Black Vein Large	26/6 to 27/–
Western Valley „	26/– to 26/6
Best Eastern Valley Large	25/– to 26/–
Ordinary „ „	24/– to 25/–
Best Steam Smalls	17/– to 17/6
Ordinary „	15/6 to 16/6
Washed Nuts	25/– to 27/–
No. 3 Rhondda Large	28/– to 29/–
„ „ Smalls	22/6 to 23/–
No. 2 „ Large	24/– to 25/–
„ „ Through	20/– to 22/6
„ „ Smalls	15/– to 16/–
Coke (export)	47/6 to 55/–
Patent Fuel	28/– to 29/6
Pitwood (ex ship)	26/– to 27/–
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	50/– to 52/6
Seconds	42/6 to 45/–
Red Vein	27/6 to 30/–
Machine-made Cobbles	57/6 to 62/6
Nuts	52/6 to 60/–
Beans	42/6 to 43/6
Peas	26/6 to 27/6
Breaker Duff	10/– to 10/6
Rubbly Culm	15/– to 15/6
Steam Coals:	
Large	24/– to 26/–
Seconds	22/– to 24/–
Smalls	15/– to 19/–
Cargo Through	18/– to 22/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England.

(7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

† Latest quotations available.

(a) Delivered Sheffield or Glasgow.

(b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Paris Tramways.

At the time the tramways were electrified it was understood that no permanent overhead wires would be tolerated in Paris, and the trolley was only authorised away from the central part of the city until such time as the companies could lay down the slot system. There is probably no instance of the temporary trolley being superseded by the slot, and there was some indignation many years ago when the trolley invaded the centre of Paris, where it penetrated to the neighbourhood of the Opera. Recently the necessity for displacing the tramline along the Cours la Reine to make room for the International Exhibition of Decorative Arts has resulted in the temporary suppression of the slot and the installation of the trolley along one of the most elegant and aristocratic thoroughfares in Paris. Now the Prefect of the Seine has presented a report to the members of the Municipal Council, in which he points out that the problem of the slot system has become complicated by the fact that the existing installations are all more or less worn out and need replacing at a cost of something like 1500f. a metre, and in the present condition of finance the burden could not possibly be borne by the Société des Transports en Commun, which has now a monopoly of the public transport in Paris and the suburbs. The Prefect has examined all the different solutions, including the replacing of the tramcars by motor omnibuses, which he affirms would cost as much as the renewal of the slot installations, and he arrives at the conclusion that there is no alternative to the adoption of the trolley, alike as regards first cost and upkeep. He believes that the objection to overhead wires on æsthetic grounds can be met by judicious arrangements.

Paris Water Supply.

The consumption of water in Paris is 10 per cent. more than it was last year, and as the rate of increase continues it is estimated that in fifteen years' time the city's needs will be no less than 900,000 cubic metres a day. At present the main supplies are from the Vanne and the Dhuis, the conduits of which are very old and are in a state that renders an interruption always possible. The works for bringing water from the Voulzie are making slow progress on account of insufficient funds, and practically nothing has been done with the Durteint supply, while the scheme to tap the sources of the Dragon has not yet reached a practical stage. The Municipal Council intends to ask for powers to raise a loan of 120 million francs for the carrying out of works necessary to provide Paris with an adequate supply of water, including an extension of the filtering beds at Ivry, which will double the present capacity within two years, and the bringing of water from Fontaine-sous-Jouy. By the completion of this latter undertaking, in 1927 Paris will be provided with an ample supply of water; but in view of the rapid increase in requirements it will be necessary to carry out a much bigger scheme to relieve the city of all anxiety as to a possible shortage in the future. This may be done either by bringing water from the Vals de la Loire or by creating big barrages in the upper reaches of the Seine.

Inland Waterways.

The importance of the inland waterways as an aid to the commercial and industrial development of the country was demonstrated in a striking manner at the national congress held at Lille, when many interesting communications were made upon canal improvements and the methods to be adopted to increase the capacity and efficiency of the waterways, especially in the direction of carrying goods cheaply and as rapidly as possible between the various producing and consuming centres, notably between Paris and the North, and the linking up of canals and rivers to shorten the journey to the ports. A proposal that aroused particular interest was to adopt electric traction on rails for haulage. As such an installation would cost from 70,000f. to 100,000f. a kilometre, the enterprise could only be carried out by a powerful company possessing a monopoly, and in the opinion of M. Notté this would be perfectly justified by the results obtained. Before this can be done, however, a great deal of improvement to some canals to permit of the navigation of barges of more than 280 tons will have to be effected. It is suggested that when electric traction is installed it will be possible to run to a regular schedule, so that barges can be picked up at different points at stated hours, thereby effecting a great saving in time.

Hydro-electric Power.

Another interesting communication was that presented by M. Eydoux, who explained the various methods employed for utilising hydraulic power in different parts of the country. In the Pyrenees, he explained, the waterfalls are abrupt and converge in small valleys. Those valleys are therefore converted into lakes. In the Massif Central there are rapid streams and rivers which can only be utilised by the creation of vast barrages, necessitating a considerable capital. In the Alps the waterfalls are harnessed directly to turbines. In all cases it was hoped that the presence of cheap electrical energy would have resulted in an industrial migration into the mountains; but so far is that from being the case that it has been found necessary to export the energy at great cost. The conclusion come to by M. Eydoux is that, so far as concerns the northern part of the country, heat generating plants should be employed for a regular distribution of electrical energy, as is being done at the present time, and the energy from hydraulic sources would be useful for peak loads. In this connection it is interesting to note that the Union d'Electricité, which largely monopolises the production of energy for industrial purposes in the Paris district, finds that the demand has already reached the limit provided for in two years' time and has ordered three new alternators for the Gennevilliers station.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

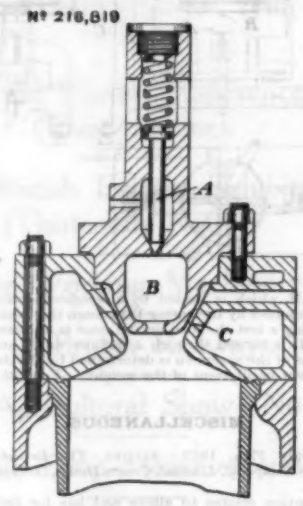
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

216,819. February 6th, 1924.—Fuel Injectors, Swan, Hunter and Wigham Richardson, Limited, Newcastle-on-Tyne; F. Rowntree, 3, King's-road, Monkseaton; and P. Belgavin, 13, Otterburn-terrace, Jesmond, Newcastle-on-Tyne.

With this form of cylinder head the fuel is injected through the valve A into a subsidiary chamber B. This chamber is separated from the cylinder cover by a narrow annular space C,

Nº 216,819



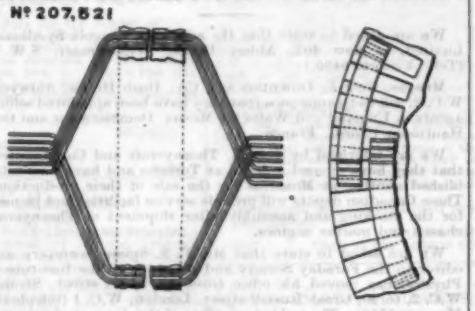
into which air is compressed by the rising piston. On the explosion stroke this air escapes again and in passing the outlet from the subsidiary chamber stirs up and thoroughly mixes the explosive charge. At the same time, however, the valve A is protected from the heat of compression of the air.—*June 5th*, 1924.

DYNAMOS AND MOTORS.

207,521. November 15th, 1923.—Improvements in Armature Windings for Dynamo-electric Machines, *The Metropolitan-Vickers Electrical Company, of 4, Central-buildings, Westminster.*

The object of this invention is to provide a coil structure wherein the ratio of depth to thickness is less at the active part of the strap in the armature slot than at its ends, so that loss of

Nº 207,521



energy due to eddy currents is minimised and the end connections are simplified. Pairs of conductors are connected to adjacent commutator bars, the thickness of each being doubled and the depth halved throughout the active portion of the coil which lies in the armature slot, the conductors being placed one above the other within the slot, and one beside the other in the end connections, as shown in the illustrations.—*June 5th*, 1924.

TELEGRAPHS AND TELEPHONES.

216,657. April 25th, 1923.—Improvements in Aerials for Use in Wireless Installations, Percy Richardson, of Gateways, Shiplake, Oxford.

The two supports or spreaders A and B are spaced at the

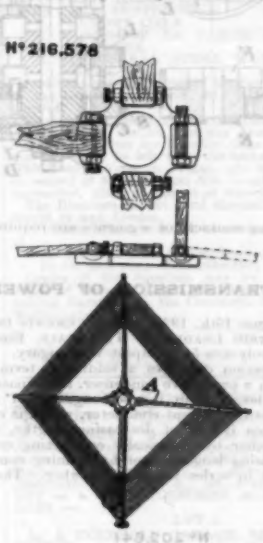
Nº 216,657

desired distance apart by bars C, so as to form a frame, which has parallel sides, and may be either of cylindrical or other annular form. The wire D forming the antennæ may either be arranged in zigzag fashion between the two supports or spreaders or obliquely, and may be either in one length or in a number of lengths. The wire is connected to the supports or spreaders, either by passing it through holes in, or hooks or eyes. One or other of the two supports or spreaders—preferably the lower one—is made of a conducting metal or material, so as to form a common terminal to which the leading-in wire is connected by means of a slip, so that its position can be varied. The other support or spreader may be made of a non-conducting material, or of a conducting metal or material. In the latter case, the wire forming the antennæ may be attached by means of insulators. By connecting a plurality of aerials of plate form together by means of hinges or other coupling devices, an annular aerial of polysided form can be easily and readily constructed. —*June 25th*, 1924.

216,578. February 28th, 1923.—Improvements in Frame Aerials, The British Thomson-Houston Company, of Crown House, Aldwych, W.C. 2, and Reginald Charles Clinker, of Tryfn Bilton, near Rugby.

According to this invention, a frame aerial is made collapsible and consists of a number of radial arms A which are adapted to support the aerial wire and pivotally attached to a central boss.

Nº 216,578

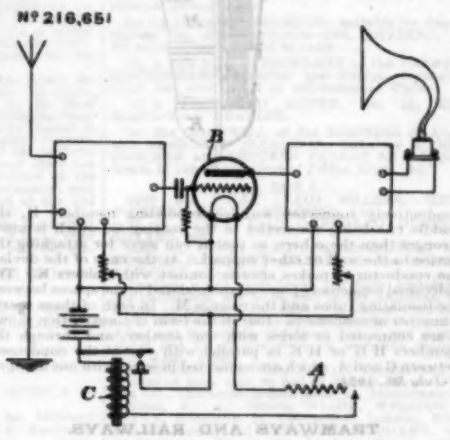


The aerial is preferably so constructed that when it is opened out the arms move slightly beyond the position in which they are when in one plane, and are so arranged that in the extended position they are kept rigid by the tension in the wire. Thus, when not in use, the frame antenna can be folded up and is compact and readily portable.—*May 28th*, 1924.

216,651. April 19th, 1923.—Improvements in or relating to the Reception of Wireless Signals, Norman Lee and The Radio Communication Company, Limited, of 34/35, Norfolk-street, Strand, W.C. 2.

According to this invention, a control A resistance is employed in series with the filament of one of the valves B which will not introduce distortion or other objectionable effects when its filament emission is reduced (for example, an early valve in the

Nº 216,651



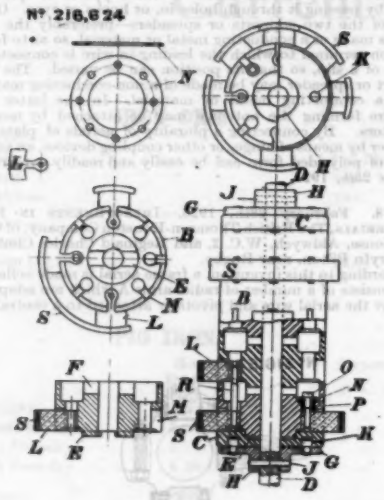
amplifier wherein the signal amplitude is small). The control resistance also energises a relay C which switches on all other valve filaments at their proper brightness irrespective of the brightness of the first-mentioned valve. It is possible to arrange that the control resistance to be remote from the receiving apparatus proper without employing heavy leads.—*June 5th*, 1924.

SWITCHGEAR.

216,624. March 29th, 1923.—Improvements in Electric Drum Type Controllers, Crompton and Co., Limited, and Walter Frederick Jones, both of Arc Works, Chelmsford.

The object of this invention is to enable a large variety of drum type apparatus to be assembled from certain standard parts, obviating the use of special drawings, parts, and tools for each variety of apparatus. The moulded sections B are preferably non-hygroscopic and are threaded on a spindle D. The sections B and the moulded ends C key into their neighbours by means of projections E and recesses F, so that when built up they form a complete drum, and this is then fixed to the spindle at each end by metal discs G with bosses H pinned at J. The discs G engage the covers C by dowel pins K. The metal contacts L are inserted into recesses M, and they are connected transversely by the metal ring N by means of screws O with distance sleeves P, or longitudinally by metal studs R. Where a longitudinal connection passes through several sections of its drum a free passage right through may not be available, and it may be

necessary to pass from one line of holes to another by means of a ring N or segment of it. S are renewable copper pieces, or they serve when ring contacts or segments are required.—*June 5th*, 1924.



TRANSMISSION OF POWER.

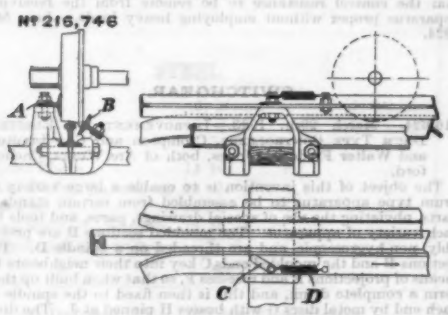
202,641. August 15th, 1923.—Improvements in or relating to Electric Leading-in Terminals, Emil Pfiffner, of Szasz Karolyutca 5, Budapest V, Hungary.

The specification describes a leading-in terminal, which is combined with a protective condenser, the capacity of which is substantially larger than the self-capacity of the leading-in terminal. A is the current conductor, which is covered by the insulating tubes B C D, of decreasing lengths, and separated from one another by electrically conducting coatings E F G, also of decreasing lengths, thereby forming condensers which are connected in series with one another. The coatings are conductively connected with corresponding members H, the middle one being connected to the coating G, which is made stronger than the others, so that it can serve for attaching the device to the wall or other support. At the ends of the device, the conductor A makes electric contact with holders K. The individual condensers L are accommodated in the spaces between the insulating tubes and the casings M. In each of these spaces a number of condensers—four in the form of construction shown—are connected in series with one another, and through the members H H or H K in parallel with one of the condensers between G and A, which are connected in series with one another. —*July 5th*, 1924.

TRAMWAYS AND RAILWAYS.

216,746. August 17th, 1923.—Checking the Speed of Colliery Pit Tubs, H. B. Sheppard, 6, The Strand, Derby.

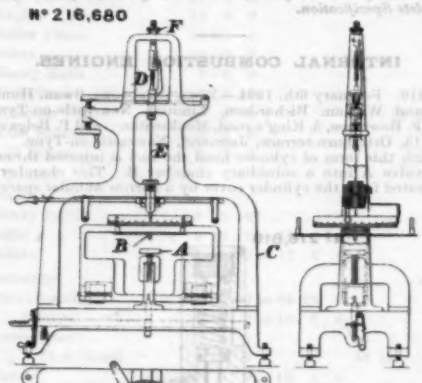
This invention is intended for checking the speed of colliery pit tubs automatically as they approach any spot where a reduced speed is advisable. It takes the form of two additional T-shaped rails A and B arranged on either side of the running rail. The tub wheel is wedged between these two rails and the friction of its face against the rail A produces the desired braking effect. The rail B is attached to the fittings by bolts passing through inclined slots C and is held up to its work by springs D. The rail can, however, be made inoperative by pulling it to the right.—*June 5th*, 1924.



MEASURING AND TESTING INSTRUMENTS.

216,680. May 12th, 1923.—Hardness Testers, The Benton Scale Company, Limited, and W. A. Benton, Borough Buildings, John Bright-street, Birmingham.

This instrument is said to furnish an accurate estimation of the so-called plastic hardness of the material tested. The specimen is mounted on the table A and on it there presses the spherical ended cone B, which is loaded by a weighted frame which is partially supported by the spring D through the torsion filament E. In making a test the load on the cone is adjusted at F and the weight C is turned through a definite angle and released. The hardness of the specimen is determined by the decrement of the subsequent oscillations of the weight.—*June 5th*, 1924.



MISCELLANEOUS.

216,389. July 27th, 1923.—Alloys, *The British Thomson-Houston Company, Limited, Crown House, Aldwych, London, W.C. 2.*

This invention relates to alloys and has for its object the provision of an alloy which is heat resisting or capable of withstanding high temperatures without excessive oxidation. It is said to have been found that an alloy having an iron base and containing from 25 to 40 per cent. of nickel, 7 to 9 per cent. of aluminium, and 7 to 15 per cent. of chromium forms a very satisfactory material for castings required to withstand high temperatures. About 1 per cent. of a purifying and grain-refining material, such as titanium, or manganese, or about 1 per cent. of both, is added for the purpose of improving the physical characteristics of the alloy, although this is not absolutely necessary. An alloy made up of the various metals in the percentage ranges given is said to be extremely tough, and is very readily cast. It may be machined, and hence is particularly suitable for castings requiring machining. The alloy may also be forged, rolled or drawn into wire.—*May 29th*, 1924.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We are asked to state that the address of Angola Syndicate, Limited, is now 402, Abbey House, Westminster, S.W. 1. (Tel.: Victoria 6455.)

Messrs. Guy F. Dowding and Co., Bush House, Aldwych, W.C. 2, ask us to announce that they have been appointed selling agents in England and Wales for Messrs. Dembiermont and Co., Hautmont (Nord), France.

We are informed by John I. Thornycroft and Co., Limited, that they have opened a depôt at Toronto and have now established another at Montreal for the sale of their productions. These Canadian depôts will provide service facilities and be used for the stocking and assembly after shipment of Thornycroft chassis and marine engines.

We are asked to state that Mr. F. S. Spiers, secretary and editor to the Faraday Society and secretary to the Institute of Physics, has moved his office from 10, Essex-street, Strand, W.C. 2, to 90, Great Russell-street, London, W.C. 1 (telephone, Museum 5718). The publishing office of the *Journal of Scientific Instruments* is now also at that address.

CONTRACTS.

The Westinghouse Brake and Saxby Signal Company, Limited, has received from the Southern Railway (South-Eastern and Chatham Railway Section) an order for 195 brake sets for electric motor coaches in connection with the Southern Railway electrification.

Royal Society of Arts.—The Council of the Society of Arts has awarded the Society's silver medals to the authors of the following papers read before the Society during the past session:—Papers read at the ordinary meetings: Sir Frank Baines, "The Preservation of Ancient Monuments and Buildings;" Sir Richard A. S. Paget, Bt., "The History, Development and Commercial Uses of Fused Silica;" Major-General Sir Fabian Ware, "Building and Decoration of the War Cemeteries;" Frank Hope-Jones, M.I.E.E., "The Free Pendulum;" Brig.-General Sir Henry Maybury, "The Victoria Dock District and its Roads;" T. Thorne Baker, "Photography in Industry, Science and Medicine;" Mrs. Arthur McGrath (Rosita Forbes), "The Position of the Arabs in Art and Literature. Papers read in the Indian Section: Brig.-General H. A. Young, late R.A., "The Indian Ordnance Factories and Indian Industries;" and Sir Richard M. Dane, "Manufacture of Salt in India." Papers read in the Dominions and Colonies Section: Dr. C. Gilbert Cullis, "A Sketch of the Geology and Mineral Resources of Cyprus;" The Right Hon. Sir Frederick Lugard, "The Mandate System and the British Mandates."

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY and SATURDAY, JULY 12TH.

World Power Conference.—At the British Empire Exhibition, Wembley. For programme see page 126.

TO-DAY to TUESDAY, JULY 15TH.

Institution of Electrical Engineers.—Visit of delegates of Overseas Technical Institutions. For programme see page 610.

FRIDAY, JULY 11TH.

Kelvin Centenary.—Connaught Rooms, Great Queen-street, London, W.C. 2. Banquet.

TUESDAY TO FRIDAY, JULY 15TH TO 18TH.

Highland and Agricultural Society.—Edinburgh. Ninety-third annual show at Perth.

WEDNESDAY, JULY 16TH.

Institution of Chemical Engineers.—Hotel Cecil, Strand, London. Second annual corporate meeting. Sir Arthur Duckham, K.C.B., will deliver his presidential address; Sir Frederic Nathan will review the work of the Education Committee on "The Training of a Chemical Engineer." Papers: "Self-balancing Centrifugals," by Mr. E. A. Alliott; "Evaporation in Currents of Air," by Mr. G. H. Himus and Professor J. W. Hinchley. Subsequently the Chemical Hall at the British Empire Exhibition will be visited. Morning, 11; afternoon, 3.30.

Institution of Railway Signal Engineers.—At the Institution of Electrical Engineers, Victoria Embankment, London. "Mechanical Interlocking," by Mr. F. R. Addis. 6.30 p.m.

SATURDAY, JULY 19TH.

Institution of Municipal and County Engineers.—District meeting in the Council Chamber, Municipal Buildings, Newbury. 11 a.m.

Physical Society of London.—Special meeting at Cambridge. Visit to the works of the Cambridge and Paul Instrument Company and inspection of the Cavendish Laboratory. Papers: (1) "Radiations in a Discharge Tube," by Sir J. J. Thomson, O.M., F.R.S.; (2) "Recent Experiments on the Artificial Disintegration of the Elements," by Sir Ernest Rutherford, F.R.S., and Dr. J. Chadwick; and (3) "A Two-dimensional Recording Accelerometer for Aeroplane Research," by Dr. G. F. C. Searle, F.R.S. Train leaves Liverpool-street Station (G.E.R.) 8.30 a.m.

THURSDAY, JULY 24TH.

Institute of Cost and Works Accountants.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner. 7 for 7.30 p.m.

FRIDAY, JULY 25TH.

Institute of Cost and Works Accountants.—Connaught Rooms, Great Queen-street, London, W.C. 2. Costing Conference. 11 a.m.

Institution of Municipal and County Engineers.—Yorkshire District meeting at Bradford.

Institution of Electrical Engineers: Award of Premiums.—The Council of the Institution of Electrical Engineers has awarded premiums, value £10 each, to the following students for papers read during the session 1923–24:—Mr. N. B. Hill, Cape Town; Mr. A. L. MacNaughton, B.Sc. (Eng.), Airdrie; Mr. V. Mitchell, Settle, Yorks.; Messrs. O. Morduch, Manchester, and A. W. Metcalf, Manchester; Mr. B. Nuttall, Manchester; and Mr. A. C. Warren, London.

A New Fastening.—We have received from Charles Churchill and Co., Limited, of 9-15, Leonard-street, London, E.C. 2, some samples of "Parker Hardened Drive Screws," which are the mechanics' equivalent of the screw nails used by some carpenters. They resemble a round-headed rivet with a steep-pitch thread running nearly to the end. There are generally six starts to the thread, which is of sharp narrow section. These drive screws are of hardened steel, and if they are started in a hole the size of the plain unthreaded end, can be driven home with a hammer. We have tried some of them and find that they will cut a perceptible thread even in cast iron—a fact which was disclosed by breaking open the test piece after the screws had been driven in. They can be driven out again from the back, but naturally hold very firmly against a straight pull. These drive screws should be very handy in the shops for many purposes, such as fixing cleating and small fittings which are usually secured by rivets or screws.

The Royal Technical College, Glasgow.—Following upon the greatly regretted death of Professor J. G. Longbottom, Head of the Department of Mechanics, the Governors have decided to amalgamate the Departments of Mechanics and Mechanical Engineering of the Royal Technical College, Glasgow, under Dr. A. L. Mellanby, who will in future be the Professor of Mechanics and Mechanical Engineering. As Associate Professor in the same department, the Governors have appointed Mr. Wm. Kerr, Ph.D., A.R.T.C. Dr. Kerr is a distinguished past student of the College, whose early contributions to the College Engineering Societies and to the Technical Press brought him prominently before the engineering world. During recent years he acted as Research Assistant to Professor Mellanby. His practical experience was obtained principally with the Fairfield Shipbuilding and Engineering Company, where he was engaged on the design of large sets of turbine machinery and gearing.

Fitting-up Bolts.—We have received from Mr. T. L. E. Haug, of 2315, Durant-avenue, Berkeley, California, some samples of bolts for temporarily securing plating in preparation for riveting, which appear to us to be among the most satisfactory devices of this kind so far devised. The object of the inventor has been to produce a bolt which can be threaded through the holes in the plating from one side and tightened up without the workman having a mate on the other side. The bolt has an L-shaped head which will pass through the hole, and opposite the head the stem is grooved longitudinally. This groove provides accommodation for a piece of stiff wire, on the end of which there is welded a serrated wedge. The bolt is put in place with the wedge leading the way. The wedge is then pulled back so that it jams the L-shaped head against the back piece of plating and the nut is tightened up. There is a loop on the end of the wire to prevent loss of the wedge. The bolt is made of tough steel so that it will stand continued use without undue wear.